INTELLIGENCE TESTS

WALTER F. DEARBORN

INTELLIGENCE TESTS

Their Significance for School and Society

BY

WALTER FENNO DEARBORN, M.D., PH.D.

Professor of Education and
Director of the Psycho-Educational Clinic
The Graduate School of Education
Harvard University

HOUGHTON MIFFLIN COMPANY

BOSTON · NEW YORK · CHICAGO · DALLAS
SAN FRANCISCO

The Riverside Press Cambridge

The Riverside Press
CAMBRIDGE · MASSACHUSETTS
PRINTED IN THE U.S.A.

TO

E. K. D.

PREFACE

It would be difficult to discuss a component or aspect of human nature and conduct as important as is intelligence without taking some account of the *homo sapiens*, or *stultus*, in his totality, of his upbringing, and of his relations with others of his species. Far from attempting in the present instance to view the subject narrowly, the author has welcomed the opportunity, which the invitation to write the following chapters afforded, to approach some of the problems of the individual in relation to school and society from a fresh angle. For, as it seems to him, the procedures developed in the testing of intelligence and the findings which have been made with the aid of the tests are sufficiently novel and definitive, as compared with the older methods and results, to warrant a canvassing of their significance and implications.

At the same time, he believes that the tests and the suppositions which underlie them are in need, especially in view of the wide use of the tests and of various misconceptions which have arisen, of critical examination. The tests are by no means perfect instruments. They have aided in the meeting of some problems; they have not advanced the solution of others, but have merely revived or thinly disguised them in new settings.

Among the latter is one of the oldest of the problems of psychology and education — that of nature versus nurture. The professional, as well as lay, opinion now most generally held is that the tests provide a means of recognizing and appraising the intellectual inheritance of the individual and that the great differences in the intelligence of individuals have been proved, by the use of the tests, to be due in the largest measure to inheritance. The writer has sought every opportunity in the following discussions to show the insufficiency of this analysis and to direct attention to the part which learning plays in determining both intelligence and behavior.

The makers of intelligence tests are repeating the mistakes of schoolmen in envisioning too narrowly what constitutes intelligence and, indeed, education. Evidence of the contracted vision of both teachers and testers has been discovered and set forth in the following discussions. It is maintained that formal schooling is too largely verbal or linguistic. The consequent hardships of those who have even minor disabilities in this respect are given what is believed to be more adequate and sympathetic recognition than has been usual in similar discussions. An analysis is also attempted of the nature of these special intellectual shortcomings. The latter have not infrequently been mistaken for more general defects and, in fact, due to present scholastic influences, often have practically the same consequences.

In attempting to sketch the background of the more recent developments in the testing of intelligence, a rather more technical discussion has been required, especially in the second chapter, than is perhaps desirable in an introductory statement. It would be better craftsmanship, no doubt, to lure the gentle reader, whose interest in these discussions is especially sought, farther afield before expecting him to take this hurdle. The subject is, however, well within his ken, and could not well be postponed.

The chapters of this book were prepared as a series of eight lectures which were given at the Lowell Institute in Boston in February and March, 1925. They have been revised and amplified in some sections which needed further discussion than was possible within the limits of time imposed by the lectures, and the first lecture has been divided into Chapters I and II of the book; but, as now published, the lectures remain for the most part essentially as delivered. In the preparation of the lectures the author drew freely from various articles of his which have appeared in psychological and educational journals and from several monographs which he has written or to which he has contributed. Passages from several of the lectures were made use of in an address before the Chicago Association for Child Study and Parental Education in March, 1926. The address has been published in the *Proceedings* of this Society (45).

In carrying out some of the experiments and under-

takings, to which reference is made in the following pages, he has had the help of faithful colleagues in the Psycho-Educational Clinic of the Harvard Graduate School of Education. He has further benefited by the work of the graduate students of the School whose labors have fallen in the general field of these discussions. One of the latter, Professor Leonard Carmichael, now of Brown University, has put him under added obligations by reading the manuscript and making a number of helpful suggestions. Dr. Psyche Cattell has drawn a number of the figures and checked the references. The manuscript has also been bettered by the corrections and gracious criticisms of his colleague of the School of Education, Mr. Charles Swain Thomas. Dr. C. Wilson Smith has generously helped with the proofs. Such faults as remain may unequivocally be laid to the author's incorrigibility.

The author had the privilege of being associated for a number of years with the late Dr. Walter E. Fernald in the teaching of college classes for the clinical study of the feeble-minded. He would consider himself fortunate if he has succeeded in reflecting, in the chapter dealing with this subject, a little of the broad humanitarianism and mellowed optimism which characterized Dr. Fernald's labors as an educator and physician.

Finally, such appreciation as he may have gained of the importance of learning and of environmental

influences in accounting for human behavior has come from years of comradeship with Professor Edwin B. Holt, now of Princeton University, who has also done him the honor of reading and criticizing several chapters of this book.

CONTENTS

LIST OF PLATES AND FIGURES

PLATES

FIGURES

LIST OF TABLES

INTELLIGENCE TESTS

CHAPTER I

THE RATING OF INTELLIGENCE BY MARKS AND BY TESTS

1. *Opinions versus Tests*

Men and women have always enjoyed the privilege of passing judgments on their fellows. The advent of the intelligence test and the wealth of its literature have enriched and sharpened their vocabularies. Think of the satisfaction and precision of concluding that one's enemy has a mental age of three, or of the refinement of describing him as a moron instead of just a plain fool! The proud father who has felt it incumbent upon himself to recount, in season and out of season, the extraordinary accomplishments of his offspring may now, if he will, save your time and his by quietly communicating the fact that his boy has an I.Q. of 170. Teachers who have hitherto had to content themselves with marking not only the intelligence, but the achievement, character, and industry of their pupils in a single series of grades of "excellent," "good," "poor," "very poor," and "failure," or of A's through B minuses, C pluses, D minuses, and E pluses, now have at their disposal, as the result of

the intelligence tests, a scale of values ranging from a mental age of three months to possibly one hundred and ninety-two months, or sixteen years, and a scale of intelligence quotients ranging from zero to at least two hundred. Through the use of achievement or accomplishment tests, they may determine accomplishment ages and accomplishment quotients of similar magnitude in reading, writing, and arithmetic, spelling, geography, history, composition, poetry, algebra, geometry, modern languages, Latin, music, chemistry, and physics. So far as the writer knows, no standardized tests, with their accompanying accomplishment ages and quotients, have as yet appeared for Greek, calculus, astronomy, or international law, but for some of these subjects tests are doubtless on the press. Finally, the teacher may assay, on the appropriate scales, the rating of the character or personality, the industry, the environment or home conditions, and even the will of his pupils. The hive of education has been humming with these developments. Is it all buzz, or is honey being elaborated in the process? This is, I take it, the question whose answer is expected in this book.

The history of education has been replete with great enthusiasms for new methods, followed frequently by disappointments with their shortcomings or with disillusionment. More than would seem to be the case in many other fields of learning, the new in education is usually met at first with what seems unwarranted

conservatism. It is then abruptly accepted and seated at the right hand of the hostess; later its credentials are examined with increasing misgivings. This has been the case with the intelligence tests, and the stage of critical examination has now been reached.

2. *The Judgments of Teachers*

In taking account of stock, we may first observe what facts in regard to intelligence may be gleaned from the judgments which men commonly make of each other — and more especially from those which teachers make of their pupils. Teachers, by the use of school marks, record their opinions in a more systematic way and give them a more quantitative expression than is customary in other callings. Teachers' opinions are, therefore, accessible for study and we shall turn our attention to them.

Success in school as expressed by school marks is determined, not only by the intelligence of pupils, but also by their interest and industry, the length of time which they have studied, their health, disposition, and other such factors. The teacher is primarily interested in rating the common result or product of these variously contributing factors. When he attempts to estimate the intelligence separately or apart from these other factors (a thing which neither the teacher nor the tester has really been able to do), his judgments are subject to certain errors, which were not

commonly recognized until the advent of the intelligence test.

3. *Faults of Judgment*

In the first place, the teacher's idea of what is normal or average in intelligence is often faulty. He ordinarily judges a given pupil in terms of the average of his own class. But unless he has had a very wide experience he has no way of knowing how his class compares with other classes, or with the average intelligence of school children. The elementary-school teachers' judgments in this respect are apt to be better than the high-school teachers', because the latter deal regularly with a much more selected and hence unrepresentative group. The judgment of most people is subject to the same error, even that of the physician or psychiatrist, whose business it is to diagnose mental deficiency, is frequently in error, particularly in borderline cases. His experience with subnormal individuals may have been really more extensive than his acquaintance with normal individuals. The writer recalls hearing the famous German psychiatrist Kraepelin discuss the intellectual shortcomings of a patient in his clinic. For comparison he cited the accomplishments, if the writer's memory is not at fault, of his own boy, who was of about the same age as the patient. The chances are that the boy, if he took after his father, was of superior rather than average intelligence and culture. The patient was thus

being compared with too high a standard. The first significant accomplishment of the intelligence tester was this: by examining all grades of intellect from the feeble-minded through the average to the superior or genius, he has been able to determine a truer average or standard by which to judge the intelligence of individuals.

The second source of error in the teacher's judgment of intelligence was, and is, in failing to take account of the differences in the ages and lengths of previous training of pupils. The pupil's intelligence was estimated on the basis of his relative performance in the particular grade in which he happened to be. The intelligence of older, over-age, or retarded pupils was thus usually overestimated, and that of younger pupils who were accelerated in grade position was underestimated. By first comparing pupils of the same life age, the intelligence tester showed that the schools have done relatively more for the dull pupil, as judged by his position in the grades, than for the bright pupil. The pupils of superior intelligence are the ones who are really most retarded in school.

These first two sources of error are purely technical matters, but they appear to be largely responsible for the differences between the results of the intelligence test and the teachers' judgments. Indeed, a recent study has demonstrated that, when these factors are controlled, the agreement between the test and the teacher is immediately increased. This investigation

discovered that some of the teachers who had been instructed to rate the intelligence of their pupils were considering brightness, and others the present mental level irrespective of the age of the pupil. In other words, some were rating in terms of the intelligence quotients and others in terms of the mental ages of their pupils. When all were taught by means of a rating scale to estimate the same thing, the coefficient of correlation (an index of the extent of agreement, in which 1 or unity represents perfect agreement) between their judgments and the results of a group intelligence test averaged .70, which is quite as high as could be expected, since the intelligence test is itself not an infallible instrument, and different intelligence tests often do not agree with each other to any greater extent (134).

4. *The Unreliability of Popular Estimates of Intelligence*

Other factors are real mistakes in judgment — such as the failure to distinguish between general intellectual deficiencies and the results of some special handicap. A special disability affecting the learning of reading, such as will be described in a subsequent chapter, may, because of the importance of a knowledge of reading for other scholastic progress, simulate a general deficiency. A specially unfavorable social environment, the speaking and hearing only of a foreign language outside of school, may have similar results. Indeed, the results of the intelligence tests

Plate I. Photographs of Children (After Pintner)

PLATE II. PHOTOGRAPHS OF CHILDREN (After Pintner)

do not escape the effects of such factors. The appearance and behavior of children also lead to false judgments. Many people think that they can distinguish the bright child from the stupid by his facial expression and general appearance, by his alertness or his keen expression, by the penetrating or knowing glance of his eyes. The lively, talkative, obliging child, who is always ready with an answer, right or wrong, is sometimes thought cleverer than the quiet, retiring child who is hesitant in speech. Facial expression, bodily carriage, and peculiar appearance may occasionally help in the recognition of extreme deficients. How unreliable they are even in these cases may be judged by the photographs shown opposite page 6. If the reader will note any such characteristics as he may be able to observe in the appearance of these children and compare them with his observations of the group, shown opposite page 7, unless he is more intuitive than the teachers, physicians, and psychologists who reported their judgments in an experiment made by Professor Pintner (98), he will hardly have sensed that all of the children whose photographs are shown in Plate I were either average or (those shown in the top row) very bright children, and those in Plate II all below average and those in the bottom row inmates of institutions for the feeble-minded.

5. *Experimental Studies of Teachers' Judgments*

Evidence of the mistaken judgments of teachers has

been shown by many studies. A frequently cited example is the experiment of Starch and Elliott (111), who sent a facsimile reproduction of a high-school student's examination paper in geometry to the teachers of mathematics of all the high schools included in the North-Central Association of Colleges and Secondary Schools with the request that these teachers mark the paper on the basis of 100 per cent. One hundred and sixteen teachers complied with the request. The grades which they assigned are shown in Figure 1. The grades assigned to this one examina-

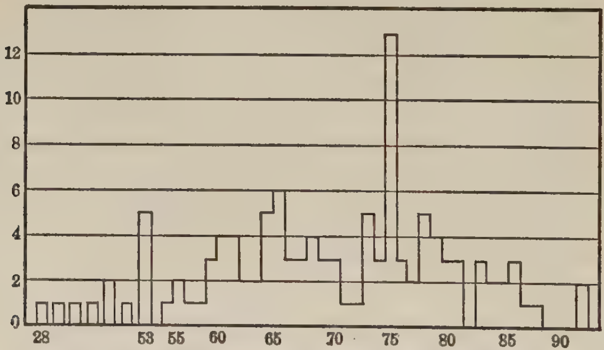


FIG. 1. MARKS ASSIGNED TO AN EXAMINATION PAPER IN GEOMETRY BY 118 TEACHERS (After Starch and Elliott)

tion paper ranged all the way from 28 to 92 per cent. The difficulty here was largely one of subjective standards of marking. If a dozen papers, ranging from complete failure to a perfectly correct, legible and neat paper, had been sent, most teachers, especially if given some suggestions as to the relative

weight to be given to correctness of answer, excellence of method, legibility, neatness, etc., would probably have ranked them in approximately the same order. Evidence in support of this assertion has recently been provided in an experimental study of Lauterbach (80).

6. *A Comparison of the Intelligence of Pupils in Small and Large High Schools*

In a recent study (48) on the Distribution of Marks in High Schools of varying size, it has been shown that the smaller the high school the larger is the percentage of excellent or of A and B grades. Thus, in Table 1 it may be seen that the percentage of A grades assigned decreases with the enrollment of the high school and the percentage of E grades increases. In Table 2 it will be seen that the percentage of A grades assigned in the smallest high school was 43.8 per cent and 2 per cent of E grades, whereas in the largest high school there were but 2 per cent of A grades and 11.9 per cent of E grades.

This again is an artificial or technical matter. The pupils from the smaller schools are, as has been shown in various ways, actually on the average inferior in attainment to those from the larger schools. Teachers in the large and small schools would not have disagreed so much if asked to rank a certain number of pupils whom each knew. Again it is simply a question of standards. In the smaller schools, as a result of more intimate contacts between teacher and pupils,

and the fact that the range of talent may be less than in the larger schools, teachers have become more generous in their grading. The same thing happens in college. The small classes are usually, to be sure, the more advanced ones, but this is not the sole reason why in general there are fewer failures and more successes than in the larger elementary classes. As Professor Max Meyer has noted in one of the earlier discussions of school and college marks: some professors would seem to regard the very fact that a student had

Table 1. The Percentage of A's, B's, C's, D's, and E's Given in Each of Five Groups of High Schools
(After Emerson, 48)

High-School Enrollment	A	B	C	D	E	No. of Cases
1– 50	17.8	31.7	28.5	18.8	3.2	1,755
51–100	13.2	35.7	26.8	19.6	4.6	3,771
101–200	14.3	29.1	29.5	20.5	6.2	4,827
201–400	8.2	29.7	28.5	24.9	8.6	7,607
2000 up	5.8	22.3	30.3	30.6	10.7	23,438
Total	8.5	26.4	29.4	26.9	8.9	41,398

Table 2. Marks Given in the Largest and the Smallest High School by Percentages
(After Emerson, 48)

Marks	A	B	C	D	E
Distribution of 30 high schools	8.5	26.4	29.4	26.9	8.9
Distribution for the smallest high school	43.8	27.5	17.8	8.6	2.2
Distribution for the largest high school	2.4	20.1	33.1	32.1	11.9

elected one of his (the professor's) courses as in itself evidence of superiority on the part of the student.

7. *The Varying Percentages of Failure in Different High Schools*

The same explanations hold for the different percentages of failure in fourteen comparable New Jersey high schools, as shown in the accompanying Figure 2 (20). The percentages range from 8 per cent of failure to 27 per cent of failure.

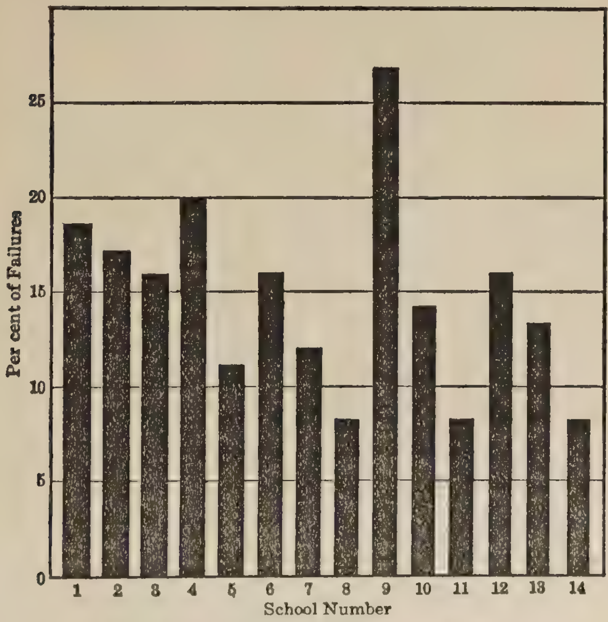


FIG. 2. THE PROPORTION OF "F" GRADES ASSIGNED IN FOURTEEN NEW JERSEY HIGH SCHOOLS (After Bliss)

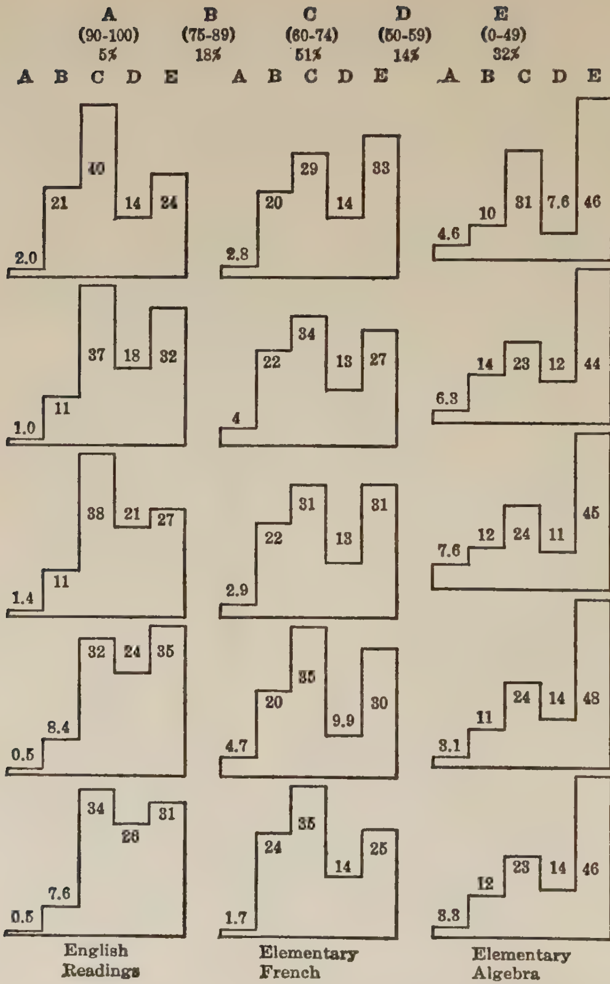
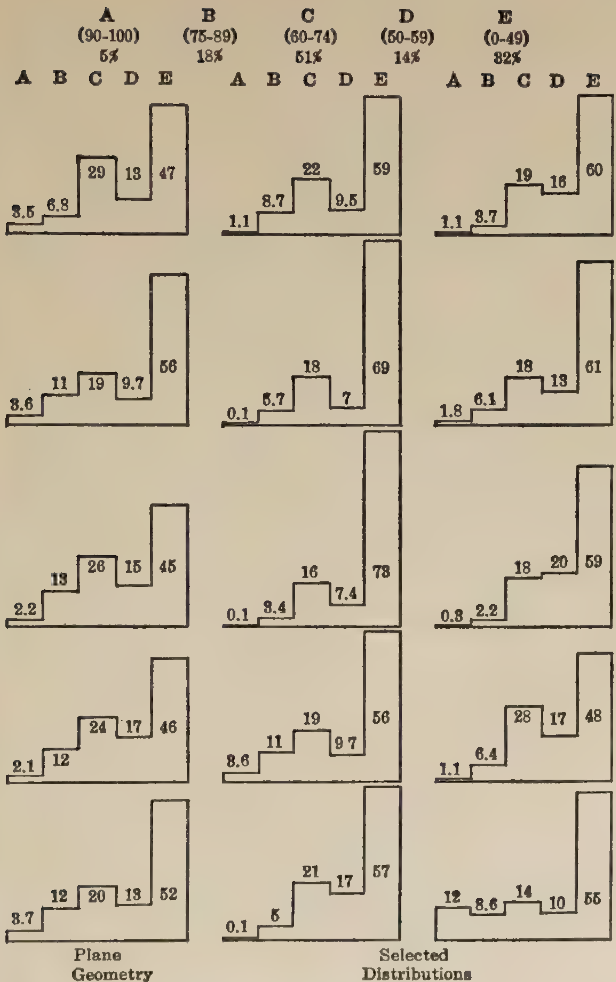


FIG. 3. DISTRIBUTIONS OF MARKS
EXAMINATION BOARD



Assigned by the College Entrance
(1902–1920) (Hopkins)

8. *Variations in the Standards of Admission to College*

The charts in Figure 3 show the variations in the percentages of what may for convenience be called the A, B, C, D, and E (or failure) grades assigned in different subjects by the College Entrance Board examiners (69). The average of all marks assigned in all subjects in the years 1902 to 1920 (a total of 445,620 marks) is shown at the top of the charts; 5 per cent of A grades, 18 per cent of B's, 31 per cent of C's, 14 per cent of D's, and 32 per cent of E's or failure. In the first column of graphs, are shown the percentages of grades assigned in five different years in English, the next column shows the percentages of grades assigned in as many different years in elementary French, the third column the percentages in algebra, and the fourth column the percentages of grades assigned in geometry in five different years. The reader will note that the percentages of A grades assigned vary from one half of one per cent in English to 7.6 per cent in algebra, and that the percentages of E grades range from 24 to 56 per cent. The latter percentage obtained in the case of one year's grading in geometry.

In the next two columns of graphs there are shown the percentages of grades assigned in a number of different subjects in ten different years. The short columns to the left show that the percentages of A grades vary from one tenth of one per cent in one subject to 12 per cent in another, and the percentages of failure (columns to the right) in one subject mounted to

73 per cent. Most of these graphs represent the marks assigned to between a thousand and two thousand examination papers, the smallest number considered being over six hundred. Practically the same types of students come up to these examinations year after year. There is no good reason why appreciably more should fail or succeed in one year than in another, or why the percentages should be different in one subject from those in another, and yet we find, as noted, variations in the percentages of A's assigned from one tenth of one per cent to 12 per cent and what is more important from 24 to 73 per cent of failures. These differences are largely due to a lack of standards in the setting papers of equal difficulty from year to year or in the grading of them uniformly. If the average percentages of marks thus far assigned, as shown at the top of the tables, were set as the standard for subsequent grading in all subjects or some other and perhaps more logical set of standards were established, a serious fault in this examination system would be remedied. Whatever the merits of the present intelligence examinations for college entrance, they are improvements in the technique of measurement. The application of this technique to existing methods of admission to college would lessen the need for the supplementary intelligence examination, at least as it is at present constituted.

9. *An Example of a Commonly Found Difference between Test Results and Teachers' Marks*

Table 3, on page 17, offers a comparison of teachers' judgments of the intelligence of pupils (whether of brightness or of mental level is not indicated by the experimenters) in terms of the letter grades E to A. with the results of intelligence tests expressed as intelligence quotients ranging from a low quotient of 50 to a high quotient of 155 (46).

There is a considerable amount of agreement. The five cases about which circles are drawn present a few striking disagreements: in one case the teacher regarded as an "A" pupil one whose intelligence quotient was below 65, and, what is more striking, considered as of "E" intelligence a pupil whom the test showed to be superior with an intelligence quotient over 125. These cases were all due to a neglect by teachers (or by the experimenters) of the factors previously discussed.

10. *Comparable Findings of Teacher and Tester*

With all their sources of error (some of which, as we have seen, might be avoided), teachers' marks have certain compensating advantages, and they are in fact still the chief criterion by which the intelligence test is evaluated. The teacher may take account of a known lack of interest or industry or of preoccupation in other than strictly intellectual activities, or he may recognize the unusual perseverance and application

Table 3. Showing the Correlation between (*a*) the Intelligence of Pupils as Measured by the Stanford-Binet Intelligence Tests (Given in Terms of the Intelligence Quotient — I.Q.) and (*b*) the Teachers' Judgments concerning the Pupils' Intelligence (Given from E Lowest to A Highest) — 130 Cases

Intelligence Quotient	Teachers' Judgments					
	E	D	C	B	A	Total
50– 55	2	—	—	—	—	2
56– 60	1	—	—	1	—	2
61– 65	3	3	3	1	1	11
66– 70	1	5	2	—	—	8
71– 75	2	7	3	1	—	13
76– 80	3	4	4	—	—	11
81– 85	2	4	7	5	2	20
86– 90	1	5	3	3	—	12
91– 95	1	4	2	1	1	9
96–100	1	3	2	5	2	13
101–105	—	1	1	1	1	4
106–110	—	2	1	2	1	6
111–115	1	—	1	2	3	7
116–120	—	—	—	2	1	3
121–125	—	—	—	—	2	2
126–130	1	—	—	—	1	2
131–135	—	—	—	2	1	3
136–140	—	—	—	—	—	—
141–145	—	—	—	—	—	—
146–150	—	—	—	—	1	1
151–155	—	—	—	1	—	1
Totals	19	38	29	27	17	130

Read as follows: Of pupils having intelligence quotients between .50 and .55, two were judged by teachers to be in the lowest fifth of their classes in intelligence. Of pupils having intelligence quotients between .56 and .60, one was judged by the teacher to belong in the lowest fifth of the class and one was judged by the teacher to belong in the next to the highest fifth. Of eleven pupils who had intelligence quotients between .61 and .65, three were judged to belong to the lowest fifth, three to belong to the next to the lowest fifth, three were judged to belong to the middle fifth, one was judged to belong to the next to the highest fifth, and one was judged to belong to the highest fifth.

which gets the individual further than his intellectual talents would alone admit. The emotional and volitional traits, the energies of the individual, his enthusiasms or inhibitions, his determination — all these affect in varying degrees the results of the test, but the tester has little way of being cognizant of them. Further, many of the findings which the intelligence tester has heralded, and some facts in regard to intelligence which he is not yet in a position to display, have been or may be discovered from a study of school and college marks.

The range of individual differences in intelligence and the proportion of individuals at different levels of intelligence may be nearly as well determined by the teachers' marks as by the intelligence test. Both approximate in their distributions the so-called normal frequency or Gaussian curve of error. The teachers' marks, as distinct from their judgments of intelligence, are, of course, given for relative attainments in school studies, but the intelligence tests, as we shall note in a following chapter, are also necessarily, in part, measures of attainment. Other reasons for this correspondence will be cited later.

Of the set of graphs on page 19 (Figure 4), the one at the top gives the distribution of the intelligence quotients of 905 unselected children of ages five to fourteen years (118). The heights of the columns indicate the percentages of each I.Q. division. The level of greatest frequency is at the center, or halfway

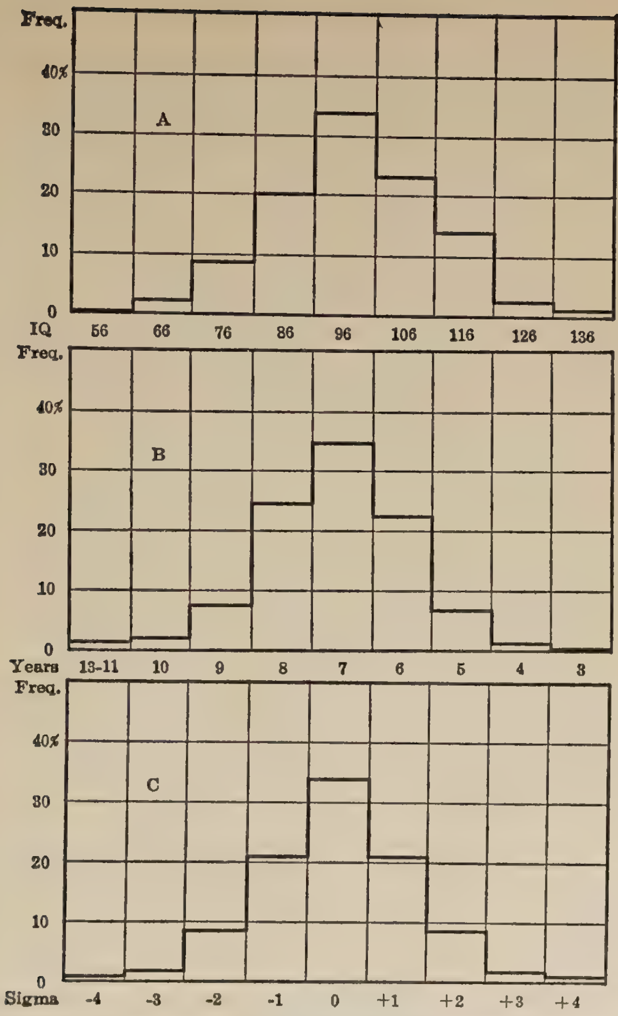


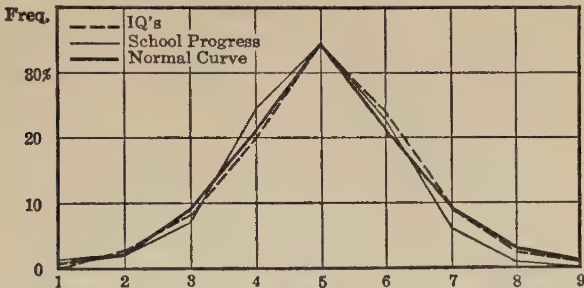
FIG. 4. (A) DISTRIBUTION OF I.Q.'S OF 905 UNSELECTED CHILDREN (After Terman)
(B) DISTRIBUTION OF THE NUMBER OF YEARS TAKEN BY 1439 CHILDREN TO COMPLETE THE ELEMENTARY SCHOOL (After Stevens)
(C) NORMAL CURVE OF DISTRIBUTION IN TERMS OF SIGMA

between the extreme variations of deficiency and genius. The distribution is roughly symmetrical, there being about the same proportion of individuals in the higher as in the lower levels. The nearer the approach to the extremes of the distribution the fewer are the number of cases.

The graph in the middle shows the number of years required by 1439 elementary-school children in four elementary schools of St. Louis to complete the eight grades of the grammar school (114).[1] The number of individuals is expressed as a percentage of the total number. A small fraction of 1 per cent of pupils, *mirabile dictu*, actually completed the eight grades in less than 4 years, another fraction of 1 per cent in 4 years, 6 per cent in 5 years, 23 per cent in 6 years, and 34 per cent, or the largest number, in 7 years. In these schools the school year was divided into four quarters of ten weeks each. Promotions or demotions were made at the end of each quarter, thus admitting of greater flexibility than in the usual school system. If we may regard the school system as in itself a great intelligence test, which it is, and if conditions admit of the pupils expressing their intelligence by their relative rates of progress, it will be seen, by comparing this chart with the top chart, that the school system and the test come to practically the same conclusion as regards the distribution of the various levels of intelligence. The graph at the bottom is that of a

[1] Daniel Starch: *Educational Psychology*. Macmillan, 1919.

normal frequency distribution for the same number of intervals. Both of the above distributions closely approximate it. This may be seen by plotting the graphs together, as is done in the charts of Figure 5.



IQ's	0.3%	2.3%	8.6%	20.1%	33.9%	23.1%	9.0%	2.3%	0.6%
School Progress	1.3%	1.7%	7.6%	24.9%	34.6%	22.8%	6.3%	0.6%	0.2%
Normal Curve	1.0%	2.0%	9.0%	21.0%	34.0%	21.0%	9.0%	2.0%	1.0%

FIG. 5. DISTRIBUTION OF INTELLIGENCE QUOTIENTS, RATE OF SCHOOL PROGRESS AND A NORMAL CURVE SUPERIMPOSED

The distribution of intelligence quotients is shown by a broken line, that of the rates of progress of pupils by a solid light line, and the normal distribution by a heavy line.

Numerous more direct examples might be cited of the resemblance between the form of distribution taken by teachers' or other examiners' marks and that of the results of intelligence tests. The following three examples will suffice to illustrate this point (Figure 6).

The first graph in Figure 6 shows the distribution of the average marks of 472 high-school students (37).

The second graph shows the distribution of intelligence ratings in the case of 1600 ninth-grade (or first-year high-school) pupils as determined by the com-

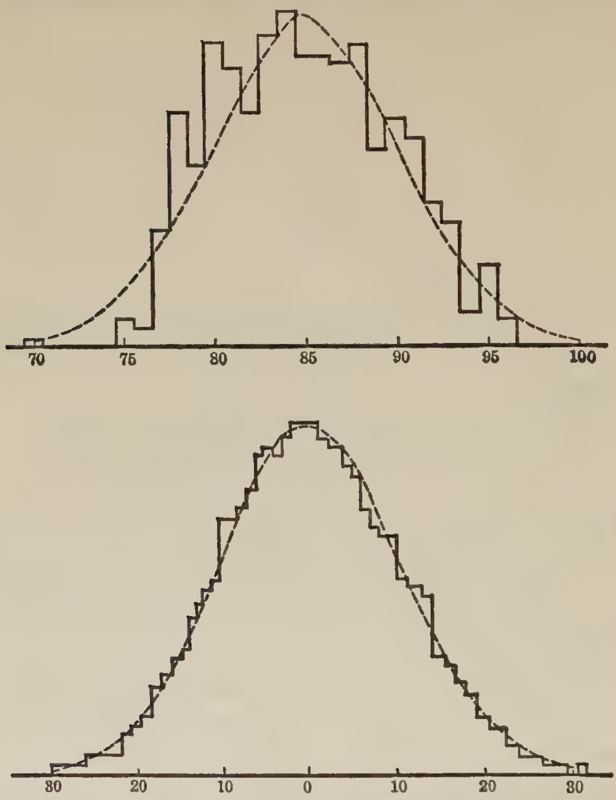


FIG. 6. (A) AVERAGE HIGH SCHOOL RECORDS OF 472 PUPILS (After Dearborn)
(B) COMPOSITE CURVE OF INTELLIGENCE TEST SCORES OF NINTH GRADE PUPILS (After Thorndike)
The broken lines indicate the Theoretical Normal Curve.

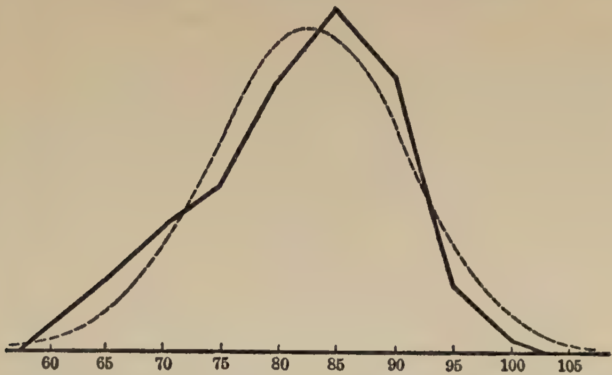


FIG. 6. (C) MARKS ASSIGNED BY A PROFESSOR TO 2334 MEDICAL STUDENTS (After Hall)
The broken lines indicate the Theoretical Normal Curve.

posite scores of nine different intelligence tests (129). The third graph is that of the marks assigned by a single teacher to 2334 medical students in the course of ten years (37).

The distributions are in each case compared with that of the normal frequency curve. The latter curve is indicated by dotted or broken lines. The approximations to the normal curve, in the case of the average of teachers' marks and that of the average of the nine intelligence tests, is very nearly the same. The professor is a little more generous in his assignments of grades than a consideration of the normal curve would warrant.

The writer is, of course, aware of the fact that the similarity between the distribution of the teachers' marks and that of the intelligence test does not argue

that the same thing is being measured by the teacher and the tester. The same form of distribution may be found in many measurements, as, for example, in the heights of students, as may be seen from the distribution of the heights of Harvard College students shown in Figure 7. That the teacher and intelligence

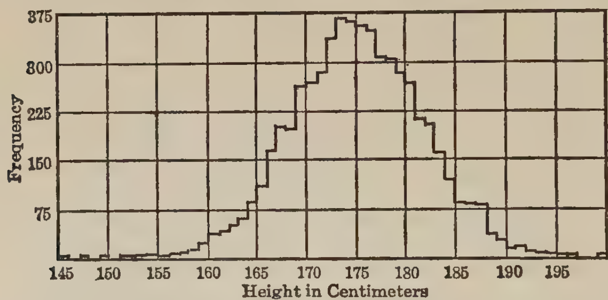


Fig. 7. Frequency Distribution of the Heights of 5870 Harvard Undergraduate Students

tester are measuring essentially the same thing will be argued in the second chapter. Assuming that this is the case, our present point is that the teacher and tester come to very similar conclusions about the range and relative frequency of the amounts of the traits which they are measuring.

11. *The Discovery of the Constancy of the Intelligence Quotient*

A second finding from the use of intelligence tests, which has been paralleled by studies of teachers' marks, is the so-named constancy of the intelligence

quotients of individuals during the period of their development. This concept of the intelligence quotient and its constancy is, according to a recent writer, making as profound an impression upon educational theory as did Herbart's doctrine of apperception. The intelligence quotient, as is commonly known, is the ratio of an individual's mental age (which is determined by his score in the tests) to his chronological age. It is M.A. (mental age) divided by C.A. (chronological age). If a child of 10 secures a score or mental age of 10 in the tests, his intelligence quotient, or I.Q., is 1, or, as more commonly expressed, 100. If at 10 he has a mental age of 12, which means that his intellectual attainments are equal to those of the average twelve-year-old, his intelligence quotient is 1.20, or, leaving out the decimal point, 120. A child of 10 who has a mental age of 8 has an I.Q. of .8 or 80. Repeated tests of the same individuals at yearly or more frequent intervals have shown that this ratio of mental age to chronological age is fairly constant year after year in at least the majority of cases. If at school entrance at age 6, a child has a mental age of 9 or an I.Q. of 150, it may be found that at age 12 he has a mental age equivalent to that of 18 years and an I.Q. of 150. If at age 6 he has a mental age of 3 or an I.Q. of .50, at 12 years of age his M.A. may be 6 and his I.Q. .50; in other words, his I.Q. remains constant.

The chart on page 26 (Figure 8) shows in the upper

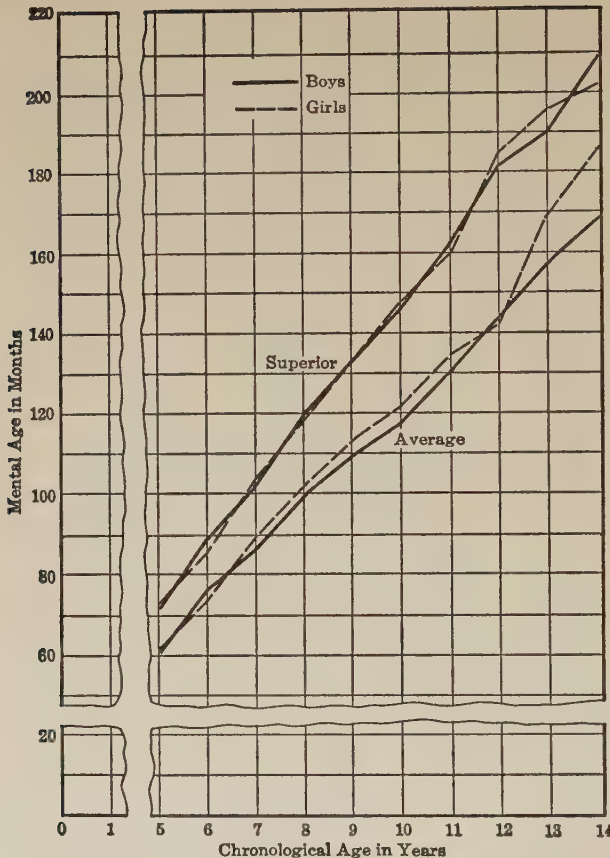


FIG. 8. MENTAL GROWTH CURVES FOR SUPERIOR AND AVERAGE BOYS AND GIRLS (After Baldwin)

oblique lines the mean mental age in successive years of a group of children who were superior to the average in their first measurements, and in the lower oblique

lines the same data for a group who were about average at the start. The dotted lines are for girls and the black lines for boys. In each case, with advancing age there is a corresponding increase in mental age, but the superior children, as a group, remain superior throughout the period from five to fourteen years. This is exactly the same finding which has resulted from the repeated measurements of the height of different individuals, tall boys at six generally keep their advantage over short boys of six throughout the period of growth (9). This is shown by the chart on page 28 (Figure 9). The lowest oblique line in black shows the growth in height of a boy who was seven years old and whose height was about forty-four inches at the time of the first measurement, and the top oblique black line the growth of another boy of the same age and about fifty-one inches tall at the first measurement. The dotted lines show the differences in the growth in height of three girls as determined by repeated measurements from the age of five to the age of seventeen. Throughout their growth they remain, in respect to each other, tall, average, and short.

There are, of course, exceptions to the rule; for we know that short children occasionally turn out to be tall men and women. The facts about the exceptions to the rule will be discussed later, but it should perhaps be noted at once that this constancy in the ratio of the mental age to the chronological age of individuals is not purely an innate quality of the mind, not

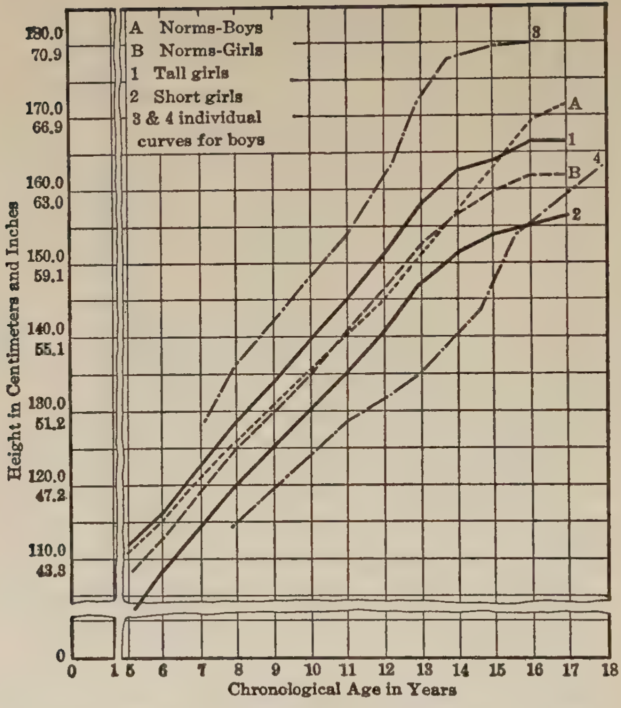


FIG. 9. GROWTH IN HEIGHT OF TALL, AVERAGE, AND SHORT BOYS AND GIRLS (After Baldwin)

at any rate to the extent to which height would appear to be innately determined, but it presupposes a like constancy in environmental conditions for the group compared — constancy in schooling, in culture or home conditions, in health, and in other similar factors. A *radical* change in any of these conditions may affect the rate of individual mental development. *Under*

constant conditions, then, it appears that in the large majority of cases one may predict from the mental test in the early years the course of the individual's subsequent development. To this possibility, of course, attaches the significance of the finding.

CHAPTER II

FORECASTERS OF INTELLECTUAL DEVELOPMENT: THE MARKERS AND THE TESTERS; THE SELECTION OF STUDENTS FOR COLLEGE

1. *Parallel Findings from Marks and from Tests*

The discovery of the constancy of the intelligence quotient and of the resulting possibility of predicting in the early years the subsequent course of the individual's intellectual development is, as has been indicated in the first chapter, by all odds the most important contribution which has resulted from the use of intelligence tests. This discovery was also, however, anticipated in the above-mentioned studies of school and college marks, although these earlier findings did not lead to the daring generalizations and acclaim which have followed upon their rediscovery by the intelligence tester. In the case of school marks no one has attempted to say in how far the constancy in standing is due to intelligence or to learning, or to attribute the result altogether to either one factor or the other factor, as would seem to be done when a man writes: "A child of ten has the same intelligence as he had at three, though he has attained greater mental growth by that time" (52). Similarly, the distinguished English psychologist, Spearman, in speaking of a certain factor common to all specific abilities to

which the term "general intelligence" or "general ability" may be fittingly applied, has, according to one of his interpreters, surmised that "it is born with one and can neither be improved by schooling nor dulled by neglect" (10). The discussion of the meaning of the constancy of the intelligence quotient or of the earlier finding of the persistence in the relative scholastic standing of pupils, we must reserve for a subsequent chapter. We wish now simply to set forth these parallel findings. What the earlier studies showed may be seen from the following illustrations.

2. *The Relation of the Standing of Pupils in Elementary School to their Standing in High School*

A group of about one hundred students in a small city high school were divided into three divisions on the basis of their average rank in the elementary school. The question was then asked: In how far do those students who stood in the various thirds — upper, middle, and lower — of their class in the elementary school maintain the same relative rank in the high school — that is, remain in similar divisions of the high-school class? The accompanying Table 4 answers the question (30). Of the pupils who were in the first third of the elementary-school class, 81 per cent maintain their rank in the first third of the high school, 50 per cent who were in the middle third remain there in high school, and 64 per cent of those who ranked lowest in the elementary school are found to be

in the lowest third of the high-school class. On the average, then, 65 per cent remain in the same divisions of the high school in which they were in the elementary school. Small variations which are of no great significance may be neglected by the comparison

Table 4. Constancy of Scholastic Ranking in Elementary and High Schools

	1 Tertile percentage	2 Tertile percentage	3 Tertile percentage
Tertile Method			
Average	81	50	64
Mathematics	75	51	78
English	66	40	53

	High tertile	Low tertile
Tertile-Median Method (per cent in extreme tertiles not varying beyond median)		
Average	90	84
Mathematics	87	84
English	81	78

made in the second part of the table (Tertile-Median Method), which shows that 90 per cent of the pupils who were in the first third of the elementary-school class maintain a position above the middle (or median) of the high-school class, and 84 per cent of those in the lowest third remain below the median of the high-school class. By averaging these two percentages,

we may express the "percentage of retention" of this elementary school in a single figure, as 87 per cent. In other words, only about 13 per cent of these students differed in rank in high school appreciably from the rank which they had attained in the elementary school (39).

The comparison has also been made for separate subjects, as shown in Table 4, for mathematics and English. The results point to a high degree of correlation between the work and standards of this particular elementary school and high school.

3. *Comparisons of the Standings of the Same Pupils in High School and in College*

The relations between standing of pupils in high school and their standing in college were first set forth in detail by the writer in an investigation conducted at the University of Wisconsin (36). The method of this study is illustrated by Plate III.

Chart A of Plate III shows the grades or averaged marks of 472 pupils from eight high schools who subsequently entered the University of Wisconsin. The numbers above the horizontal line have been assigned to different pupils, and the grade of the students is shown by the column in which his number is placed. For example, No. 520, at the extreme left of the chart and above the grade 70, shows that the individual so numbered received marks in the four years of his high-school course which averaged 70. Pupils who

received lower grades than 70 could not ordinarily be candidates for admission to the University. The numbers 261, 260, 288, which are located above grade 96 at the extreme right of the chart, thus indicate that the individuals for whom these numbers stand received high-school marks which averaged 96. In order to facilitate the comparison about to be made, the numbers of these pupils whose marks place them in the first or highest quarter of this combined class are colored *red.* Those who rank in the second quarter of the group have been given a purple colored number. Those in the third quarter a green colored number, and those in the fourth or lowest quarter of the group a black number.

The following Chart B shows the grades of these same students in the freshman year in the university. It will be sufficient for us to note that the "red" students of the high school, if we may abbreviate our descriptions to this extent, are the ones who, for the most part, make up the first or highest quarter (in standing) of the freshman class. The actual percentages are as follows:

Sixty-four per cent of those who were in the first quartile in the high school remain in this same quartile in freshman year; 81 per cent of them remain in the first and second quartiles, only about a fifth therefore fall below the median of the class, and but four per cent fall into the lowest quarter of the class. The percentages of students remaining in the other

Plate III. Relative Standing of Pupils in High School and College (After Dearborn)

Chart A

High School Grades (general averages) of 472 Pupils from 8 High Schools

No. in Quartile I = 118
" " " II = 118
" " " III = 118
" " " IV = 118

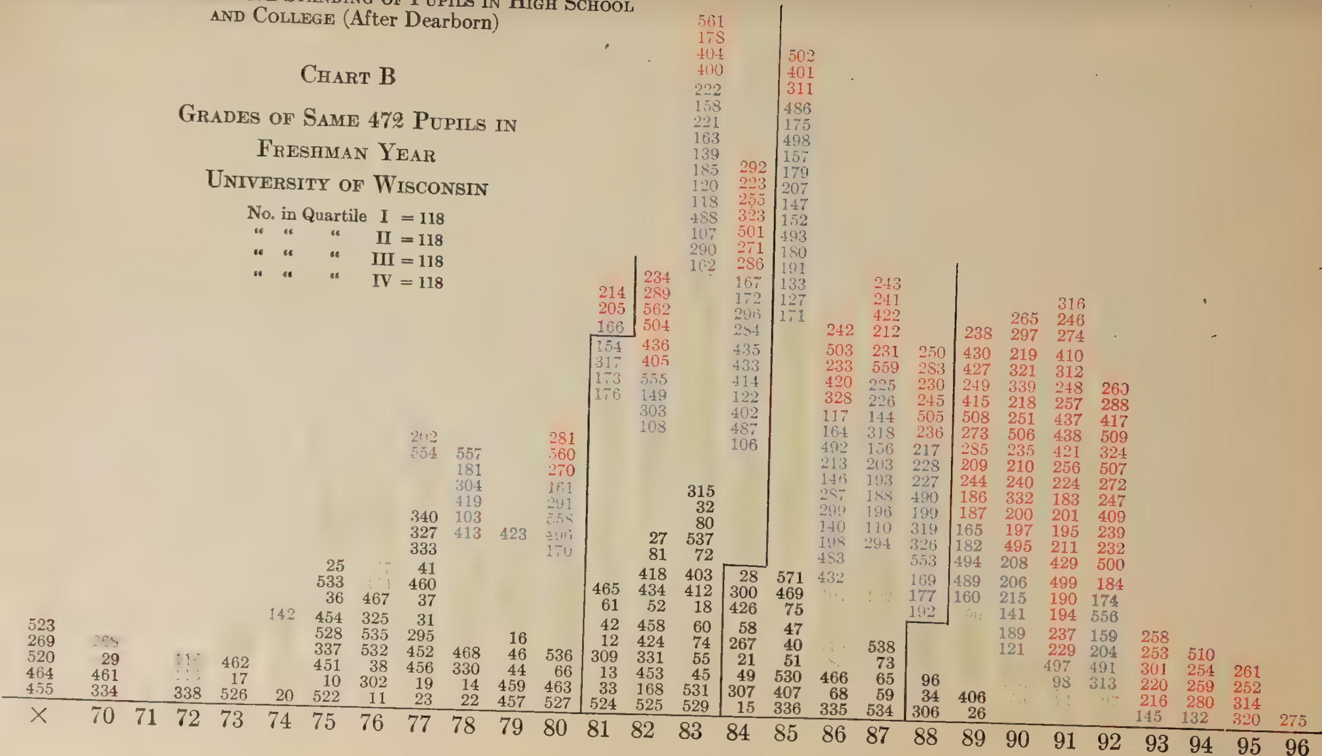
						72																
						73								328								
						66					554	203		495								
						68					483	116	492	174								
						25					106	115	207	165								
						418					110	181	213	217								
						300					553	185	208	161								
						75					160	117	159	164								
				529		426					419	180	139	175								
				36		403					98	193	147	498		235						
				37		412					169	191	152	167		504						
				424		58					432	140	144	222		212	245					
				38		16					103	198	146	158	501	178	219					
				31		267					107	133	145	166	186	239	220					
				12	461	325					413	189	206	225	233	502	273					
				295	55	463	406				173	120	154	182	205	271	505					
				309	47	464	315				294	188	149	172	499	503	321					
				306	434	465	27				290	132	204	157	332	183	339					
				407	40	330	29				313	304	215	179	187	201	285	234				
				307	333	462	32				108	121	141	228	232	195	437	248				
				13	51	65	80				177	196	296	268	236	210	438	323	509			
			17	336	45	18	81				176	127	287	494	190	211	421	507	265			
			19	331	14	60	96				192	199	284	496	270	240	422	230	246			
			23	334	49	327	28				162	202	435	497	200	436	218	272	241			
			302	335	52	26	466				171	118	433	227	500	281	320	247	324			
			168	33	41	21	269				170	122	318	226	184	280	223	242	238		250	
			337	452	42	20	34					402	414	221	194	429	209	289	274		258	
			451	453	46	74	467					319	303	163	237	405	256	249	297		253	
			338	454	44	59	340					317	299	423	197	401	244	257	410		259	
			10	455	458	61	468					486	491	291	231	404	224	409	430		275	
			22	456	459	535	469					142	493	558	229	400	216	415	427	510	417	
	11		526	457	460	534	538					326	156	557	286	214	251	255	314	252	301	261
	522	15	525	528	531	533	537					487	489	556	420	311	506	508	312	243	283	260
520	571	523	524	527	530	532	536					488	490	555	559	560	561	562	292	254	316	288
70	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96

Plate III. Relative Standing of Pupils in High School and College (After Dearborn)

Chart B

Grades of Same 472 Pupils in Freshman Year University of Wisconsin

No. in Quartile I = 118
" " " II = 118
" " " III = 118
" " " IV = 118



three quartiles in which they were in high school are less, namely, 40, 31, and 46 per cent for the second, third, and fourth quartiles, respectively.

One reason for the greater interchange of standing in the middle quartiles is, undoubtedly, the fact that the grades of "fair" and "good" are less carefully differentiated to begin with than are the grades of "excellent" and "poor," or "failure." There are nearly twice as many students found in the medium grades as in the higher or lower grades; to the relatively few in the extreme grades it seems likely that marks are assigned more discriminatingly than to the many in the medium grades, who, because of their number, must really differ from each other by small amounts. This explanation is further consistent with the known facts in regard to the distribution of mental abilities; there are many more individuals possessing the medium range of abilities than there are of those who are either exceptionally well endowed or exceptionally deficient. Most individuals differ from each other and the average only by small amounts; few only differ greatly from the common range of abilities. It is quite natural, then, that marks representing chiefly the teacher's estimate of the individual differences in the abilities of his pupils should be similarly distributed; that is, many ranked about the average, few at either extremes, either of excellence or deficiency. Since, as just stated, it is hard to discriminate between the small differences of the many, the

greater interchange between these two intermediate quartiles results.

Only five of the pupils who stood in the lowest quarter of the group on entrance succeeded in reaching the rank of the first quartile, and they secured only the lowest grade in the quartile; similarly, but five of those who entered in the first quarter of this large group dropped to the lowest quarter during the freshman year; and they stood in the highest rank of this quartile. We may say, then, on the basis of the results secured in this group, which is sufficiently large to be representative, that if a pupil has stood in the first quarter of a large class through high school, the chances are four out of five that he will not fall below the first half of his class in the university. And the opposite facts are nearly, if not quite, as true; the chances are but about one in five that the student who has done poorly in high-school work — who has been in the lowest quarter of his class — will rise above the median or average of the freshman class at the university, and the chances that he will prove a superior student at the university are very slim indeed. What is true of the standing of students in the high school holds in just about the same proportions throughout the sophomore and junior years.

From an inspection of these charts we are justified in drawing the general conclusions that those students who are the best scholars in the high school are, usually, the best in the university, and similarly, that the poor

scholars in the high school tend to remain so in the university.[1]

4. *A Comparison of the Relative Standings of the Same Pupils in Elementary School, in High School, and in College*

The relative constancy in the standing of pupils first in the grade school, secondly, in the high school, and thirdly, in the college is shown in the diagram on page 38 (Figure 10), which traces the records of 158 students through these three scholastic levels. The group was divided into three parts on the basis of standing in the elementary school. Of the 53 students who were in the lowest third of the group in the elementary school (see column on the left), 31 were in the lowest third of the group in the high school, and 23 of these same

[1] The Pearson coefficient of correlation between the standings in high school and the standings in the freshman class for this group of 472 pupils was reported to be + .80. In preparing copy for Plate III, a number of errors or inconsistencies were discovered in the original plate. These have been corrected, in so far as it was possible to do so in the absence of the original data, and a half-dozen arbitrary changes have been made in the numbering. The Pearson coefficient, after eliminating the questionable cases in Charts A and B of Plate III, is + .60. The coefficient of correlation between the school standings of 238 pupils (a part of the larger group which came from a single high school) and their standings in the freshman class is found to be + .65. The correlation between the standings in high school and standings in the freshman year in the case of a group of 180 pupils, who subsequently graduated from the University, is + .59; the correlation between their standings in the freshman year and their standings in the sophomore year is + .74; between their standings in the sophomore and junior years + .77; and between their standings in junior and senior years + .78.

students were in the lowest third of the college group. The dotted oblique lines indicate some of the possible shifts in rank; for example, of the 52 students in the middle third of the elementary-school classes over one

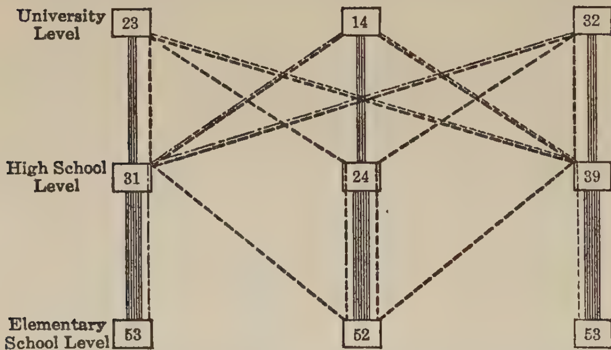


Fig. 10. Constancy of Scholastic Standing between Elementary School, High School, and College (Dearborn)

half passed to either the low third or to the upper third, of the high-school classes, some held these new ranks in the colleges, others dropped back to their former status, and so on. From the column on the right, it may be seen that 39 of those who were in the highest third of the group in the elementary school retained this rank in the high school, and 32 of these students maintained this same rank in college.

In the study (32) from which the present illustration is chosen, Dr. J. A. Clement, then a student of the writer, thus followed the course of a large number of students through various elementary schools, high

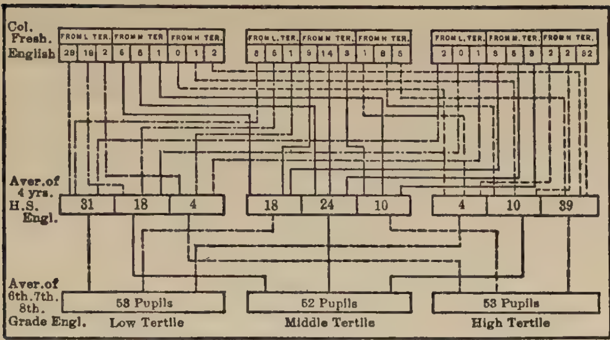


FIG. 11. RETENTION OF SCHOLASTIC RANKING THROUGH GRAMMAR SCHOOL, HIGH SCHOOL, AND INTO COLLEGE (Clement)

schools, and colleges. The complete details for this particular group are shown in Figure 11, and in the "percentages of retention" in Table 5.

TABLE 5. CONSTANCY OF SCHOLASTIC RANKING IN ELEMENTARY SCHOOL, HIGH SCHOOL, AND COLLEGE

Elementary school — Colleges	43.4	26.9	60.4
High school — Colleges	74.2	54.4	82.1
Elementary school — High school	58.5	46.2	73.6

A pupil starting in any third of the group in the elementary school has, according to this scheme, nine possible paths by which he may reach college; he may take rank in either the high, middle, or low third of the high school class, and finish his course in any one of the thirds of the college class. With these nine possibilities of fluctuation, it is interesting to find that in the high third of the class over 60 per cent take the straightest course — that is, they go from the first rank in elementary school to first rank in high school, to first rank in university.

The percentages of those keeping the same rank in the

high school as in the elementary and again in the college as in the high school are naturally higher than as between the elementary school and the college.

These results may best be expressed in terms of the percentage of pupils in the high and low thirds of the class who do not change their relative position sufficiently to cross the middle line of the class (Tertile-Median Comparison), as shown in the following Table 6.

Table 6. Constancy of Ranking in Grammar School, High School, and College (Tertile-Median Method)

Grammar Sch. 5 —	High Sch. 5 —	Coll. 2	= 70%	(90 cases)
Grammar Sch. 6 —	High Sch. 6 —	Coll. 3	= 75%	(90 cases)
Grammar Sch. 1 —	High Sch. 1 —	Coll. 1	= 85%	(158 cases)

From the three sets of comparisons in this table we may conclude that in these schools about 75 per cent of the pupils keep approximately the same rank from the elementary school to the college.

Finally, a fourth study may be cited (75) in which the relation between marks in the elementary school and in the high school are expressed in terms of the coefficient of correlation. A perfect correlation is expressed by 1.00, the absence of correlation by zero. Table 7 shows that between the marks received in the separate grades and in the first year of high school, the coefficient of correlation is in the neighborhood of .60 to .70. When the marks of the last four years were arrayed in this study (which eliminates the smaller fluctuations of standing), the correlation between this average and the standing in high school was found to be .80, which is the same extent of re-

lationship as reported in the study above cited between standing in high school and standing in college. From these and other similar studies, we may conclude that it is not unusual for eight out of ten pupils to maintain about the same rank in grammar school, high school, and college.

TABLE 7. CORRELATIONS BETWEEN MARKS IN THE GRADES AND MARKS IN THE FIRST YEAR OF HIGH SCHOOL
(From Starch after Kelley)

First year high school and 7th grade..............	72
First year high school and 6th grade..............	73
First year high school and 5th grade..............	53
First year high school and 4th grade..............	62

President Lowell, in a study (86) of the marks at Harvard College, has carried the comparison a step farther and has shown that the students who take high rank in college, quite irrespective of the subject-matter of their courses, are the ones who take superior rank in the professional schools of law and medicine.

5. *The Significance of Studies of School and College Marks*

In commenting on these studies in an address before the Harvard Teachers' Association in 1913 (39), the writer finds the following statement of his which at least recognized the possibility of changing scholastic attainment by changing the scholastic opportunities, but otherwise runs close to the assumption of the intelligence tester that we are dealing with a quality of

mind with which one is born and which is not materially changed by schooling.

> The consistency of performance from the early to the late years of school life in the case of such large groups of students, as is shown by these results, is not without significance to the student and administrator interested in the possibilities of educational prognosis.
>
> The results bear also on the more general question of nature versus nurture, of the mental differences due to inborn capacity and those due to training. Students appear from these studies to maintain in surprisingly large numbers from the elementary school to the college the relative rank with which they began. The diversity of training in school and college is perhaps after all not great — the comparison would gain interest, if groups of students could be compared whose intermediate training between the early years of the elementary school and the college or the professional school differed much more than is the case of those students who pursue the regular courses and methods of study — but taking the results as they stand, they appear to indicate that the changes which school training produces are not sufficient to overbalance the differences in mental ability which are there to begin with.

This statement gives the basis for the previously expressed opinion that these early studies of school and college marks display exactly the same phenomenon as is now currently discussed under the rubric "constancy of the intelligence quotient." We shall later, as above noted, attempt an analysis of the factors involved in this concept; we wish now to show the practical contributions of these paralleling studies to the problem of the selection of students for college.

6. *The Selection of Students for College*

In all of the examples above cited the comparisons were made within single school systems — in the first instance between the grammar school and high school of a small city; secondly, between the high schools of a single State (Wisconsin) and the State University; in the third example, between the grade schools, high schools, and colleges of the State of Kansas; in the fourth instance, between the grades and high school of a single city; and in the last case, between the college and professional schools of a single university. Although these relations are in no instance particularly close, they make for a certain uniformity in the standards of grading. When students come from a wide range of schools to a single college, their scholastic grades lack even this uniformity of meaning. In a recent study (13), which we are about to cite, the 423 candidates for admission to Harvard College whose records were examined prepared for college in 202 schools in 36 States. This situation is chiefly responsible for the present problems in the selection of college students, and provides an illustration which is particularly illuminating for our present discussion and thesis. The problem, at least from the standpoint of the college, is to select the candidates who are most able or fitted to do the work of the college *as eventually judged by the marks of the college instructor.* To the two traditional methods of selection, first the scanning of the students' preparatory school record, and secondly the

college entrance examination, there has recently been added a third method, the general intelligence examination for college entrance. The relative merits or advantages of these three methods are now much under discussion and investigation. The writer would venture to suggest that it is not so much the method as the extent to which the standards of grading employed are uniform and similar to that of the college, which determines the relative success of these methods of selecting pupils for college.

This suggested interpretation of the reason for the relative success of these competing methods of student selection is borne out by a study of comparative findings. It would take us into too many details to argue the matter, but some samples of recent findings may be shown. As may be seen under Section A, Table 8, at Harvard College the preparatory school marks are, according to the investigations there cited (13 and 82), a somewhat better means of selecting students who will succeed in college than are the college entrance examination grades. The correlations between school marks and the college marks of the freshman year, under two different plans of admission are .69 and .56, whereas the correlations between the grades on the college entrance examination range from .47 to .57. A combination of school marks and the entrance examination grades would appear somewhat superior to either method alone. The coefficient of correlation is .65 (Roman numeral I and II). In the next series (138) under B

TABLE 8. CORRELATION BETWEEN COLLEGE MARKS AND DIFFERENT METHODS OF SELECTING STUDENTS FOR COLLEGE[1]

I. Preparatory School Marks
II. College Entrance Examination
III. Intelligence Examination

CORRELATIONS

		Correlation (r)	
A			
(I) School marks with freshman marks (old plan, Harvard)		.69	(I)
(I) School marks with freshman marks (new plan, Harvard)		.56	(I)
(II) College entrance examinations with freshman marks (old plan, year 1897)		.57	(II)
(II) College entrance examinations with freshman marks (old plan, Harvard)		.47	(II)
(II) College entrance examinations with freshman marks (new plan, Harvard)		.50	(II)
(I + II) Av. of school marks + entrance exam. grades with freshman marks (Harvard)		.65	(I + II)
B	1st year	(2nd year)	
(III) Thorndike Intelligence examination with college marks (Columbia)	.59	.67	(III)
(II) New York State Regents' examinations with college marks (Columbia)	.57	.64	(II)
(II) College Entrance Board examinations with college marks (Columbia)	.43		(II)
(I) School marks with college marks (Columbia)	.33	.26	(I)
C			
(II) College Entrance examinations with freshman marks (Bryn Mawr)		.57**	(II)
(III) Binet I.Q. with freshman marks (Bryn Mawr)		.25*	(III)
(III) Thurstone Intelligence examinations with freshman marks (Bryn Mawr)		.31*	

**Means of 3 years. *Means of 2 years.

[1] For studies from which the above table is compiled, see references 6, 13, 82, and 138.

the new intelligence examination at Columbia College (see Roman numeral III) is slightly superior to the State Regents' examinations and each is superior to the entrance board examinations and the school marks submitted at that institution. In the third series of correlations (at Bryn Mawr College) under C (6), it appears that the college entrance examination grades offer a much better method for selecting students than do the intelligence examinations. Such conflicting results do not lend support to any one of the methods advocated, and simply point to differences in the materials used in the various comparisons. In general the correlations are not as high as those which the writer has cited between school marks *within the same school systems* where the standards of grading are more nearly the same or similar.

Similar results have recently been reported from like comparisons at Princeton University (24). The correlations between the College Entrance Board examinations and college grades, in the case of the old plan of admission were in the neighborhood of .50; with the new plan they were between .30 and .47; the correlations between psychological tests and academic work were between .40 and .50 and the correlations between psychological tests and the college entrance board examinations about .40. In contrast, the correlation between average standing in the first term of college and that in the second term as expressed in college marks was .83, and the correlation between the two psychological tests was .72.

The school marks, the entrance examination grades, and the intelligence examination grades are in each instance, it must be remembered, compared with the marks of the college instructor, who is thus set up as the *arbiter elegantiarum* of the academic world and of its intelligence. If the marks or grades in any instance happen to be distributed in about the same frequencies as the college instructor's marks, this fact in itself would tend to contribute toward the correlation of standing, and the absence of such similarity in distribution would automatically tend to decrease the chance of high correlation. This fact may be readily seen in the distribution plotted in Figure 12, and in the percentages of Table 9 (13). The form of the distribution of examination grades is clearly more nearly like that of the first-year college marks than is that of high-school marks. Practically the same percentage of students get C grade in the examinations as in the first year of college, 52 per cent and 51 per cent (see Table 9); and approximate in the percentages of B grades obtained, 27 per cent and 36 per cent; whereas in the school marks there are 53 per cent of B and 29 per cent of C grades. This change in proportion, of course, means that even if the college teachers considered all those who received B grades in school abler than those who received C grades in school, there are not enough B grades in college to go around, and some of the B students of the school must take C grades in college. While it is still possible for the college teachers to rank

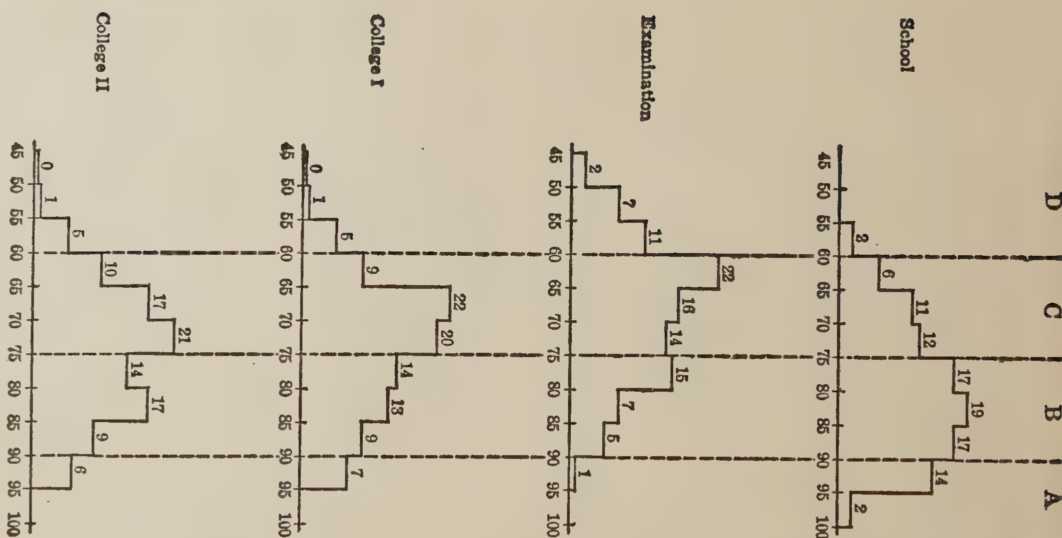


FIG. 12. DISTRIBUTION OF AVERAGE MARKS OF 423 STUDENTS IN SCHOOL, COMPREHENSIVE EXAMINATION, FIRST YEAR COLLEGE, SECOND YEAR COLLEGE (Beatley)

From *The School Review*, Feb., 1922. By permission of the Univ. of Chicago Press.

these pupils in the same order by the numerical grades — and that they do this to some extent is the reason, of course, why the correlation between standing in high school and standing in college is as high as it is, since the degree of correlation depends mainly on the fewness of changes in rank — the mere practice of assigning different proportions of grades makes the doing of this more difficult, and thus makes for real as well as apparent differences between the judgments of the school and college teacher.

TABLE 9. PERCENTAGES OF MARKS ASSIGNED TO THE SAME 423 STUDENTS, (1) WHEN IN SCHOOL, (2) IN THE COLLEGE ENTRANCE EXAMINATIONS, (3) IN THE FIRST YEAR OF COLLEGE, (4) IN THE SECOND YEAR OF COLLEGE

MARKS	D (per cent)	C (per cent)	B (per cent)	A (per cent)
1. School	2	29	53	16
2. Examination	20	52	27	1
3. College I	6	51	36	7
4. College II	6	48	40	6

7. *What Sort of Students Succeed in College?*

The problem of admitting the right students to college appears thus at present chiefly one of the uniformity of standards rather than one of the method of selection. Each of these methods, the school marks, examination grades, and intelligence tests, would likely under uniform conditions be about equally suc-

cessful in selecting the students who will succeed in college work. If now we inquire what sort of student it is who succeeds in the college, we raise a question which is at present agitating the psychologist who is interested in mental tests. He has called his tests tests of

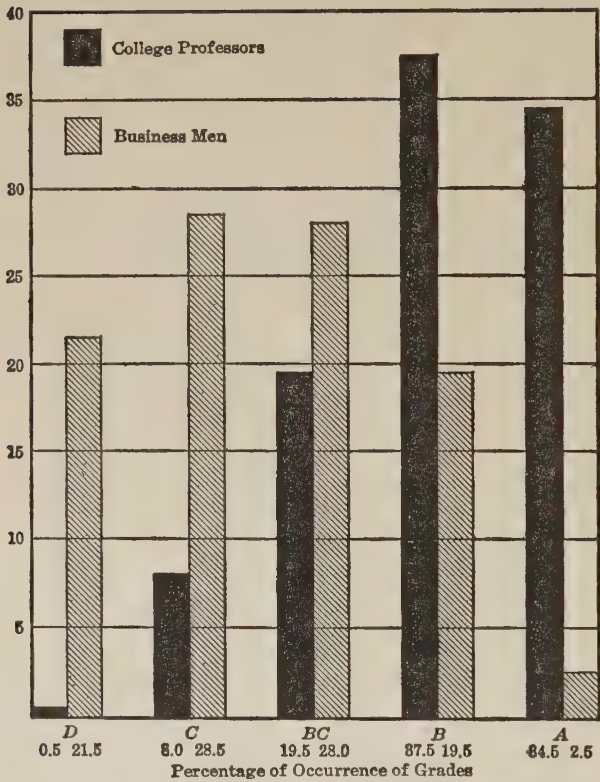


Fig. 13. The College Grades of College Professors and Eminently Successful Business Men (After Langford)

general intelligence. Do they in fact test general intelligence, or is it a special type of intellect on which the school and college, as well as the intelligence tests, set a premium? An answer to this question is suggested by a comparison of the college marks of men who after leaving college have shown undoubted talent in very different directions; in the professions, in business, in art, literature, music, statecraft or politics (79). In Figure 13 a comparison is made of the college marks of students who subsequently attained eminence as college professors with the college marks of students who later were unusually successful in business. The college marks of the professors are shown by the black columns, the grades of the business men by the shaded columns. The marks of the professors were chiefly A's and B's, the marks of the business men C's and D's. Among the latter are included some of the country's greatest bankers, manufacturers, captains of industry, and men of affairs, yet their average grade in college was what has been commonly known as the gentleman's grade of C.

This designation and all that it connotes have been thought to be indicative of the chief reasons why these young gentlemen do not get higher grades, but this can hardly be the case. For one thing such considerations offer no help toward the explanation of the following comparison of the college grades of two groups of professors. The distributions of Figure 14 show the actual numbers of the various academic grades re-

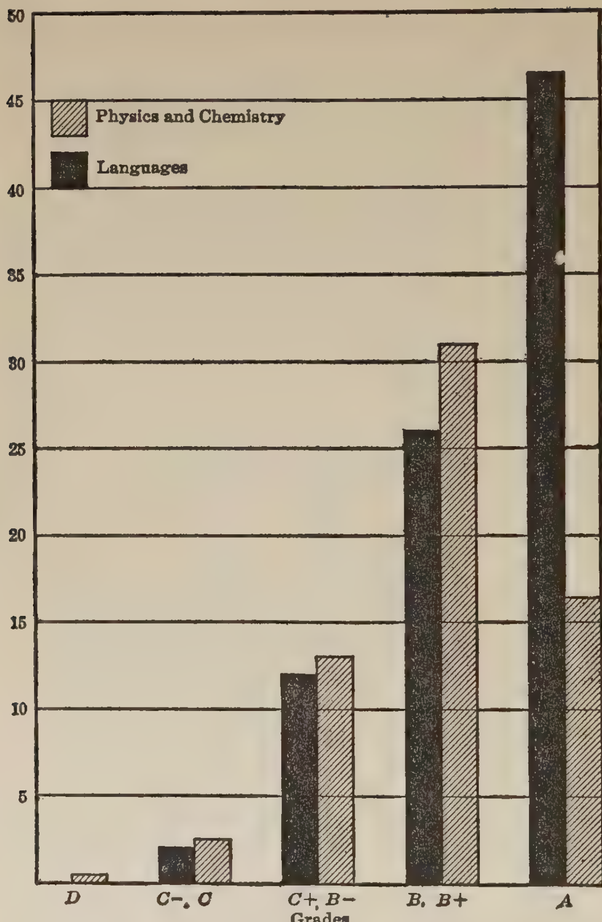


FIG. 14. THE COLLEGE GRADES OF COLLEGE PROFESSORS OF MODERN AND ANCIENT LANGUAGES AND COLLEGE PROFESSORS OF PHYSICS AND CHEMISTRY (After Langford)

ceived by forty professors of ancient and modern languages and thirty-eight professors of physics and chemistry in their undergraduate years in Harvard College. No gentleman's agreement enters here. There are very few grades of C in either group; in fact, the propriety of this designation in the first instance may well be called in question, for, as President Lowell has remarked, there is nothing especially gentlemanly about mediocrity. The professors of language as college students far outstripped any other class of students, including their future professional colleagues. They received nearly thrice as many grades of A as did the professors of physics and chemistry.

One other group may be mentioned — that of the politicians, using the word in the older and more commendatory sense, those versed or experienced in the science of government — senators, congressmen (the former incidentally rank somewhat higher in marks than do the latter), and diplomats. These men as a group — there are, of course, individual exceptions — were, as the business men, about average in their college standing.

Various explanations of these more or less invidious comparisons may be offered. It is not our purpose to choose an explanation, until at least we have examined in a subsequent chapter the contributions of the intelligence tests to the matter. We wish now simply to point out that the makers of the intelligence tests are faced with the same problem. The psychologist who

writes, "if intelligence is the ability to think in terms of abstract ideas, we should expect the most successful intelligence tests to be just those which involve the use of language and other symbols" (120), would evidently not hesitate to award the laurel, as does the college, to the professors of Latin and Greek and of the modern languages. He who holds that there are three different kinds of intelligence, the abstract, the concrete, and the social, would on this hypothesis explain very patly the academic records of the business man and of the politician (125).

Studies of school and college marks, although they have, as we have shown, anticipated some of the findings of the intelligence test and raised some of the same problems, do not offer the same promise, as do these newer methods, of further contributions. In subsequent discussions we shall, however, find it profitable to have considered these earlier studies.

CHAPTER III

THE TESTS OF INTELLIGENCE

1. *A Comparison of the Test and the School Examination*

The test differs in certain respects from other methods of estimating intelligence and has certain advantages. Our concern in the last chapter was to show that the commoner and older methods of subjective judgments and school examinations still had their place in the sun. Our present purpose is to set forth why the intelligence test also has its place and has in part supplanted these older methods.

There is one distinction which, although not a thoroughgoing one, can ordinarily be recognized between the intelligence test and the school examination. The school examination requires a special bit of knowledge which has usually been recently acquired; the intelligence test tests the use of old and fairly common knowledge often in a new or somewhat unusual way. It is true that in some examinations original problems are set, but their solution ordinarily depends on the content of a course of study which the student is pursuing. On the other hand, it must also be said that there is nothing especially original about many intelligence tests. Some are plain tests of knowledge, but, in what are considered the better tests, it is at least knowledge which the ordinary experiences of life have,

or should have, forced on the individual, rather than knowledge which has been acquired from the schools or from the special disciplines of occupation or profession. There is, as we shall see, some justification for including elementary-school knowledge when all the individuals compared have had considerable schooling, because the knowledge sought is then fairly common to all.

The difference is one of proportion or emphasis and is not consistently maintained, but one of the characteristics of a good intelligence test is that it puts to the proof fairly common experiences rather than special learning. The point may be illustrated by a series of questions originally proposed by Binet and now called tests of comprehension. In the most widely used revision of the Binet tests, the Stanford, they appear with some additions at four different age levels in the scale; at ages four, six, eight, and ten. At age four the questions are: What must you do when you are sleepy, what ought you to do when you are cold, or when you are hungry? At age six: What's the thing to do if it is raining when you start to school; if you find that your house is on fire; if you are going some place and miss your train or car? At age eight the questions are: What's the thing for you to do when you have broken something which belongs to some one else; when you notice on your way to school that you are in danger of being tardy; and what's the thing to do if a playmate hits you without meaning to? And at age ten: What

ought you to say when some one asks your opinion about a person you don't know very well? What ought you to do before undertaking something very important? Why should you judge a person more by his actions than by his words?(118).

2. Deeds versus Words in Tests and in Examinations

Few children of the ages at which the questions are set will, under the ordinary conditions of town and city life, have missed the experiences which are necessary for answering these questions. The problem is, to be sure, put to the child by proxy; that is, words are substituted for the real situation. The situation is one to be imagined rather than actually met, and some failures are indeed due, not to the lack of the appropriate behavior patterns, but to a lack of words or of their understanding, or perhaps of imagination. A premium is thus often set in the tests on verbal rather than on practical knowledge; and this holds, of course, for the school examination as well as for the tests. But just as laboratory methods have released somewhat the hold of verbal knowledge on the examination, so, as we shall see, psychologists are trying to substitute deeds for words in at least some of the tests. In these instances it is probably hardly feasible to starve or freeze the four-year-old, to set the house of the six-year-old on fire, or to stage an "act" for the eight-year-old to see what each would do in the case of hunger, fire, or accident, but we should recognize that these are

limitations in the testing methods to the discussion of which we shall shortly recur. With these reservations in mind, there is not much difficulty in deciding that the ten-year-olds who answer the question as to "what they ought to do before undertaking something important," by replying, "Take your time and figure it out"; "Get all the details you can"; "See whether it would be possible," have profited a little more from the experiences of life than those who answer: "Wash your face and hands"; "Get a lot of insurance"; or "Go to school for a long time" (118).

The child who gave the last answer might, to be sure, get the experience, of which he at least recognizes the need, by further schooling, but — and this is the point which we started to make — it is unlikely that he will have the chance to make use of it on his examination paper. The examination questions are more likely to be, "What are the names of the New England States or of the continents," how to spell the word "believe," or to reduce a fraction. Even if he is asked how corn is grown, what is made from wood pulp, or even how to set up a radio set, these questions do not draw on common experience quite to the extent that the above-cited questions do.

3. *Tests versus Puzzles*

In this respect the intelligence test resembles the puzzle or the riddle. The latter ordinarily calls for no special learning, but rather for a little ingenuity in us-

ing the ordinary experiences of life. So, for example, the riddle of the Sphinx, "What animal walks in the morning on four legs, at noon on two, and in the evening on three?" Binet's disarranged sentences, the Porteus mazes, the Freeman-Healy puzzle boxes, and Burt's analogies are tests of this order. In the Binet test the subject is asked to arrange a set of words like the following in such order as to make sense, "For The Started An We Country Early At Hour." Burt in describing his analogies test says: "I have taken the title for this test from an Aristotelian term which means 'proportion.' The exercise is, in fact, 'rule of three' in words instead of numbers. The essential instructions are: 'In the blank space provided for the answer, fill in a fourth word standing in the same connection with the third word as the second word does with the first.'" For example, "London is to England as Paris is to France."

The following tests are cited, by way of illustration, from a list of one hundred proposed by Burt (27):

Prince is to Princess as King is to ....
Heat is to Cold as Summer is to ....
Wash is to Face as Sweep is to ....
Seeing is to Eye as Hearing is to ....
Tears are to Sorrow as Laughter is to........
King is to Emperor as Kingdom is to ....

The puzzles and riddles whose solutions depend on a chance association, on some quite unusual experience, or on a fanciful, fantastic resemblance do not, however, make good intelligence tests. They are, indeed, more

akin to the intelligence test than to the examination question, but, as the catch question is tabu in the examination, the element of surprise is not desirable in the test. Ballard in his recent book (10) illustrates the matter by comparing an old riddle with an example of the analogies test, and remarks that the riddle is a test of "perverted ingenuity" rather than of intelligence; that it is, in fact, a "jest rather than a test."

The riddle is: What relation does a loaf of bread bear to a steam engine? and the test: Complete the analogy: As a loaf of bread is to a glass of water, so is eating to .... The answer to the riddle is "mother"; for a loaf of bread is a necessity, a steam engine an invention, and necessity is the mother of invention.

In contrast to the riddle, the analogy test, while calling for some ingenuity, depends for its answer on orderly and well-established associations. It samples the common experiences of mankind.

The reason for this emphasis in the present testing of intelligence upon the use which an individual can make of the common knowledge and experiences of mankind will be understood if we review the earlier literature dealing with the growth of the intellect and of the means of testing its development. Other considerations which have determined the characteristics of the present intelligence test will thus also be apprehended.

4. *Early Studies and Estimates of Intellectual Growth*

In the traditional descriptions of the development of

the intellect, it was usual to describe first the development of the senses, then the development of perception, of memory, of association, imitation, imagination, conception, judgment, and reasoning. In thus describing these various aspects of mental development, the development of the mind as a whole was frequently not clearly envisaged. If a parent should wish to gauge the development of his child, he might note that in various respects, as in sensory discrimination, as of colors and sounds, in his forming of concepts, in his acquirement of speech, and in the growth of his vocabulary, the child was the equal of, or was superior or inferior to, the children described in the literature treating of the matter, but he might still remain in doubt as to whether on the whole (and that is what he usually would wish to know) the child's development should be considered normal (or average), retarded, or accelerated. This unsatisfactory condition, from the standpoint of the parents' inquiry, may be attributed in part to the fact that the literature had dealt with special phases of development rather than with development as a whole, and in part to another condition — namely, that existing studies were seldom based on a sufficient number of children of different ages to make it possible to decide as to what was normal or what exceptional in a child of a given age (44).

5. *Tests of the Senses as Indices of Intelligence*

To pursue the former matter a bit further, we find

that just as the studies of intellectual development dealt chiefly with aspects or separate capacities the search for tests of the intellect also at first followed much the same methods. At one time it was thought that tests of the acuity of the senses would do, since all intellectual life must depend ultimately on some sensory experience. But it was soon found that individuals might have very defective sense organs, or, as in the case of Laura Bridgman and Helen Keller, be bereft of the chief avenues of sense and still give evidence of a very considerable development of intelligence.

Tests of the higher senses having failed, it was thought that, since the sense of touch is genetically more fundamental than either sight or hearing, a test of tactual discrimination might indeed prove to be a veritable touchstone of the mind. The writer recalls the great expectations aroused in his student days, at least in some quarters, by the perfection of a new instrument, the æsthesiometer, which by measuring the sensitivity of the skin would also test the acuity of the mind. The idea seemed to be, as Ballard has put it, "that if a man was thick-skinned he was thick-headed as well."

6. *Anthropometric Measures*

Each new proposal had its day in court. The anthropologist had long sought for some correlates of the mind in the physical measurements of the indi-

vidual's body. The facts that college students are taller and heavier on the average than the average of the general population, and that children who are accelerated in school are on the average taller and heavier than retarded children of the same age, are still cited as evidence of some correlation between size of the body and that of the mind. Although no one had been reckless enough to attempt an intellectual classification based on the tall or fat, on the one hand, and the short or lean, on the other hand, a practice once came under the observation of the writer in the course of a city school survey which was evidently motivated by the foregoing consideration. Sections of the school grades of one large elementary school had been made on the basis of differences in height, tall children in one room, average in a second room, and short children in a third room. This method of sectioning was considered by the principal to be quite as satisfactory as one proposed by the writer for classification on the basis of differences in intellectual ability, and considerably easier to apply.

One of the most persistent notions has been that of a relationship between the size and shape of head or of the cephalic index and intelligence. If there is any such relationship, it is so small that this notion is also being relegated to the *limbum fatuorum*, where it will take its place beside the bumps of the phrenologist and the noses and the cheek bones of the physiognomist.

7. *Tests of Motor Skill*

When physical measurements failed, it was then argued that the functions of the body or its skills should be measured. Since all thought and intellectual activity eventually results in action, it was — and is still — believed by many that tests of motor skill, of the precision and accuracy of movement, would give the desired differentiation. But some of the most intellectual men are notoriously clumsy and awkward, if one confines attention to gross bodily movements or even to such fine adjustments as are involved, for example, in handwriting.

8. *Tests of the "Higher" Intellectual Processes*

Finally, after the failure of these indirect methods, interest centered on direct tests of what seemed the more distinctly intellectual processes, those of attention, perception, memory, association, and reasoning. But here too it was soon found that not all who are inattentive or lacking in concentration are feeble-minded, and that an individual may excel in memory and still be adjudged feeble-minded in other respects. The case of reasoning seemed somewhat different; it appeared that here was the distinguishing mark of intelligence. Binet, whose more distinctive contribution we shall cite presently, wrote: "To judge well, to comprehend well, to reason well, these are the essential activities of intelligence." But to reason well there must be some basis of experience; knowledge is re-

quired, and this in turn depends on memory and attention.

9. *The Proposals of Binet and Simon*

So in the long search no single mental process was found which could be identified with intelligence, and no single test was constructed which was equal to the task of appraising intelligence. This was the situation but two decades ago. The marked change which has been brought about since then is due to the genius of two Frenchmen, Binet, and his collaborator, Simon. As not infrequently happens, the discoveries — for such they are — seem so simple that one wonders that they had not been thought of before, and their importance is at first minimized. Two important changes were introduced by Binet and Simon. The first and more obvious was that, since no single test was sufficient, a combination of a number of tests or problem situations might be used, the average of which would give a more representative value than any one test alone.

In the choice of tests, Binet preferred those which called for good judgment and reasoning. These were in the nature of problems, at first simple, then of increasing difficulty, but always within the range of common experience. On the other hand, Binet kept many of the older tests — such as that of rote memory, and the discrimination of weights which had been previously used as tests of separate capacities. It was

not then so much the sort of test, but his idea of combining or averaging the results of the separate tests and problems which was the primary reason for the success which he achieved.

Such a method does not attempt to do justice to the specializations of ability. One individual may be characterized by an extraordinary plasticity or strength of memory, another be conspicuous for rare powers of imagination, and a third for an unimaginative but acutely logical mind. Further specialization of abilities may be found within these general divisions of the mind; one person's memory may be much better for some things than for others; another may reason well in mathematics and poorly in finance. These differences cannot be neglected in describing the intellectual development of any given individual; yet the fact remains that the most important recent advance in our knowledge of the growth of the intellect has come about through a method which obscures these differences by striking a balance or average of the individual's abilities to find a measure of his general, or as it might perhaps better be called, "average" intelligence.

10. *The Concept of Mental Age*

The usefulness of this method was greatly enhanced by a second and also very practical proposal: that comparison of individuals could be made in terms of the average development or attainment of children of

various ages, the now familiar concept of mental age, that, for example, a boy of ten who can pass only mental tests which the general run of seven-year-old children can pass may be said to have a mental age of seven and give evidence of possibly three years of retardation in mental development. In order to establish such mental age norms, it was necessary to test large numbers of children of all ages. This has now been done in nearly all the civilized countries of the globe, so that for the first time the psychologist is in a position to say what is normal and what is exceptional, at least in the matters which the tests evaluate.

11. *The Distinctive Features of Present-Day Tests*

With this brief review of the development of the present instruments for the testing of intelligence, we are prepared to resume our consideration of the characteristics of the tests. We have seen that perhaps the distinctive feature of a good test is that it puts to the proof fairly common experiences rather than special learning, that it calls for ingenuity in making use of these experiences in situations as yet untried, or in the attacking of problems as yet unsolved by the individual, and, secondly, that the methodology of the tests requires a sort of sampling or averaging of the individual's abilities. In the actual application of each of these principles in the tests in current use, certain limitations appear which curtail the value of the tests and to which we shall now give attention.

12. *Limitations of the Tests*

From this discussion, it follows that the measurement of the actual process of representative learning or of intelligence actually at work is the best way of determining intelligence, but for practical reasons, such as the great length of time required for the observation of significant learning, a large majority of the tests in common use are not so much tests of the actual process of learning, of the actual operation of intellect, but are tests of what has been learned; that is, they are tests of the products of intelligence. The assumption is made that tests of information or of knowledge show how well intelligence has worked in the past and will presumably work in the future. But this is not necessarily the case. Individuals differ greatly in the organization of their experiences; some have their information always on tap, their intellectual equipment ever prepared for prompt response to at least ordinary demands of life; their reactions are matters of seconds.

These individuals may, however, be merely clever persons. In some instances, like smart schoolboys, they may have learned the answers without having been to the pains of solving the problems for themselves. Others may require more time to marshal their forces; but it is not simply a matter of time or speed of reaction. Their minds may not be well organized to meet the demands of everyday life, but may for this very reason be able to deploy their forces the more effectively in meeting unusual or novel sit-

uations. With due recognition of the advantages of habits well adapted to the daily tasks, a man may turn out a genius partly because he has not become a creature of habit.

13. *Objective versus Subjective Tests*

Even when real problems are set, they are likely to be so set by the tester as to prescribe or limit the method of solution, for problems which admit of too varied response are disturbing to the scorer. Answers which call for much subjective judgment on the part of the scorer are tabu in the tests. The intention is that the tests be susceptible of objective rating. It must, however, be noted that, in the present stage of development of objective methods of rating, much insight into the intellectual operations of the subject may be lost through this requirement of objectivity in scoring.

In any event, the persons who set their own problems, who find problems where there are supposed to be none, and who thus change the face of the earth and of the heavens above may not be recognized by the tests. Those of an inventive or creative turn of mind *may* do well in the tests because of the skills which they have incidentally acquired; or they may not do as well as they supposedly should, because their minds are not so well organized for set tasks as are the minds of the efficient persons with whom they are compared. In either case their distinctive qualities

are not discoverable by the tests. Such considerations lend support to the following statement of the German psychologist, Stern (113): "The I.Q. designates those individuals in the mass which have the strongest *reactive* intelligence; but it is not certain at all, it is not even probable, that these versatile and 'clever' individuals are always the ones who possess the greatest creative and productive qualities."

Certain other limitations arise in the application of the methodology of the tests. This requires, as we have seen, a sampling of the results of learning in matters where all the individuals tested have had an equal chance at learning. Since, however, it is difficult to find even simple experiences which are common to all individuals of a given age period, actually, again, one tries by sampling a large range of fairly common experiences to strike an "average" which, despite the fact that a given individual may have missed this or that experience, will still be representative of the individual's learning (42).

14. *Linguistic Emphasis in the Tests*

Such a battery of tests may, however, fail of its purpose of striking a fair average if too much weight is given in the tests to any special ability. The result then becomes a weighted average instead of a simple average. It is now generally recognized that the Binet tests are thus weighted; linguistic and scholastic abilities are given a little too large a place in the gen-

eral estimate of the individual's development. This is especially true in the upper ages of the revisions of the Binet tests. Among the tests of the higher ages are tests of the subject's vocabulary, of his knowledge of abstract words, of the fluency of his verbal associations, of his ability to read and report on what he has read, of his ability to understand fables. Children from homes where a foreign language is spoken, or from homes of certain social levels where there is little interest in reading, or where even conversation is very limited in scope, are at a disadvantage in these tests. The development of their intellectual abilities may, however, be considerable, only it has taken a quite different course. This is another limitation of this series of tests. For this reason other tests (of skill in performance, of practical ingenuity, etc.) are being proposed in which linguistic and, in general, scholastic training does not play so large a part. Even a child brought up in a cultivated home may sometimes show a surprising slowness in the development of some single ability, and it is always necessary before coming to conclusions about his mental development to take cognizance of other balancing factors. A perfectly normal child may occasionally be a year or more behind the average of his age in learning to speak. This sometimes happens in the case of an only child who is brought up with adults, and has had little acquaintance with other children. Such a retardation may be overcome by subsequent acceleration when the child

finally essays speech. Before this occurs, his development may be better gauged by his greater skill in using his hands, in his recognition of color and form, by his knowledge of direction and locality, in his appreciation of the niceties of dress, and in his social behavior in general. Such observations simply show the need of extending in practice the fundamental ideas of Binet which have been set forth in this discussion (44).

The emphasis on linguistic abilities may also be seen in the more recent group tests of intelligence. A cursory inspection, for example, of the Terman, the National, the Otis (higher examination), and the Thorndike intelligence examinations will provide the reader with sufficient illustrations of the predilections of the intelligence tester in this direction. In an extensive trial of the Thorndike Intelligence Examination for High School Graduates at the University of Pittsburgh (106), it was found that a high rank in these tests was associated with a high score in the Binet test, and as the report puts it, "a large vocabulary" and, contrawise, a low rank in these tests by a low mental age and a small vocabulary. The highest correlation reported in this study was found between the ranks of students in this test and their standing in a freshman course in "Human Progress." This course, according to the investigators, dealt with a large number of arts and sciences in a semi-philosophical way, and a premium was placed in the course on general information and linguistic ability.

According to this evidence, this test extends both the merits and the limitations of the Binet tests to the testing of the higher ranges of intelligence.

15. *The Need for Non-Verbal or "Performance" Tests*

In others of these recently devised group tests an attempt has been made to correct this linguistic emphasis. This has been done fairly successfully in the tests for young children, less successfully in tests for older children and adults. Samples of these less linguistic tests are shown on the adjacent pages (47). The first reaction to these tests is apt to be that from such simple tasks one can surely not learn much about the intelligence even of children. They follow, however, the same method as the Binet tests of accumulating one bit of evidence after another until the total result becomes impressive.

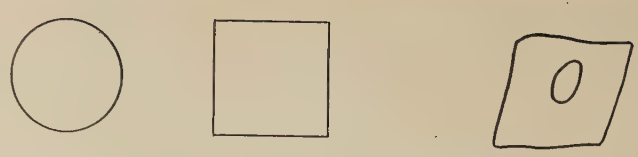
16. *Examples of Performance Tests*

In Figure 15 there are shown a few of the simple tasks of a group test designed by the writer (40)[1] for children in the first three years of school. They require the use of pencil, of counting, and the understanding of simple verbal directions, but for the most part they draw on experiences quite as common outside of the school as in school. In the first test (of General Examination A) the child is asked to make

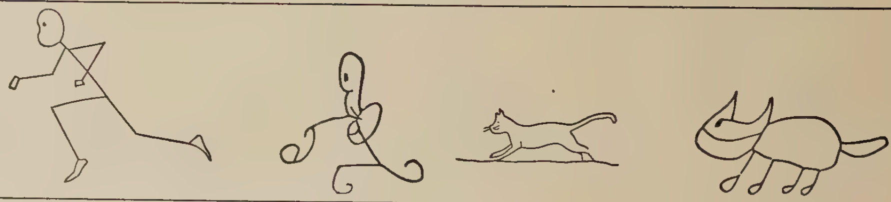
[1] The Dearborn Group Test of Intelligence, Series I, General Examination A. Philadelphia, Lippincott, 1922.

another "box" like the one shown and to put another "ball" into the box. The drawing of circles and squares is an accomplishment of children of three or four years of age, if they have had the usual opportunities in the use of pencil and paper. In Test 2 the "subjects" are asked to find the picture of a boy who is running and then to draw another boy to run after him, and then to draw a dog to chase the cat. The responses shown in Figure 16 are those of a first-grade girl of seven and a half of Italian parentage, who can read only the first few lines of the primer and can write only her first name, but who can understand the simple oral directions of the test and is thus able to give evidence in the test of more intelligence than her present scholastic accomplishments would indicate. In the scoring of Test 2 one point of credit is given if the picture of the boy has a head, trunk, two arms and two legs, a second point if he is running; the dog is similarly scored. The third test requires the keeping in mind and execution of three simple directions, a performance which in the Binet test is expected of five-year-olds. Test 5 calls for the drawing of an apple and the cutting of it in halves, and Test 6 inquires as to which is the heaviest and the lightest of the articles shown. Shoes on tired feet are sometimes undoubtedly heavy, and to the little "subject" in question seemed heavier than the coal hod. In Test 7, the subject is asked to draw a line in the shorter of the two roads, the one which will get a schoolboy from his

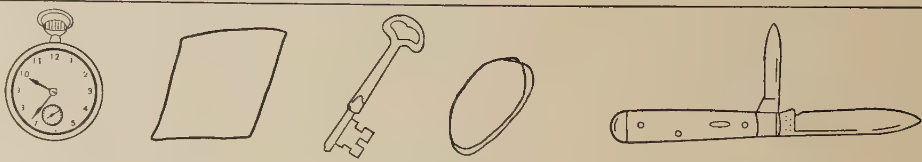
1



2



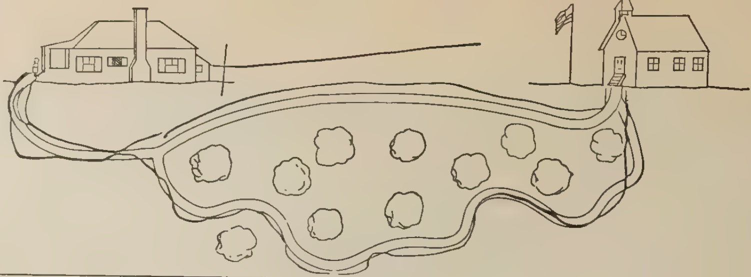
3



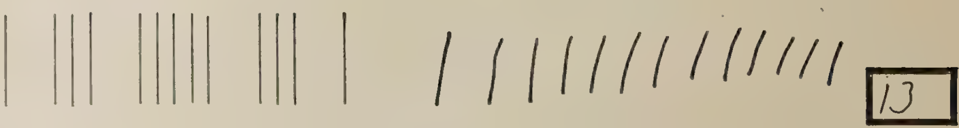
5

6

7

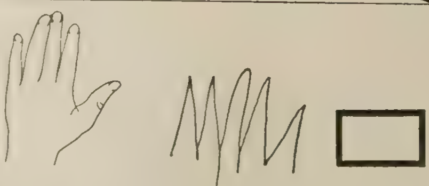


9



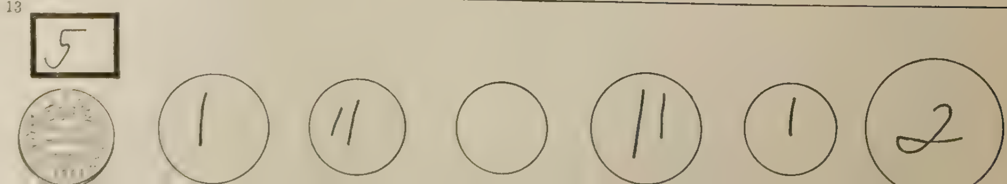
10

11



12

13



house to school the "quickest." Since both roads are designated, either the problem was not sensed, or the temptation to try both was too great to be resisted. Test 9 calls for the reproduction of the same number of "sticks" as shown in the illustration, and Test 10 for the drawing of a diamond. The latter task is seldom accomplished by children under seven years of age. In Test 11 the subject is asked to draw a right hand; in Test 12 a star, tests which are usually passed by seven-year-olds. In Test 13 the subject is asked to "make money" by marking "one" on all the rings of the same size as the penny and by making two marks on all the rings of the same size as the quarter; then to count how many pennies and quarters he has made and how much money he has made altogether in dollars and cents. The tests thus advance in difficulty until the abilities of the best of the third-grade pupils are taxed to their limits.

Figure 16 illustrates one of a second series of tests designed for use in the fourth to the twelfth school grades (41).[1] Each row of four pictures will "tell a story" if the pictures are arranged in the right order. The correct order is illustrated by the numerals in the lower left-hand corners of the first row of pictures. In this series of tests, each non-verbal test is paralleled by a verbal test, so that each type of response may be given approximately equal weight. The first two

[1] The Dearborn Group Tests of Intelligence, Series II, General Examination C. Philadelphia, Lippincott, 1920.

Example A

Example B

(2) *Directions:* Number the following words to show their proper order. Put the numbers directly under the words as in the following examples.

A.	dinner	supper	breakfast		A
	2	3	1		
B.	fruit	flower	seed	plant	
	4	3	1	2	B

FIG. 16. PART OF A GROUP TEST OF INTELLIGENCE DESIGNED FOR GRADES IV TO XII (Dearborn)

sample lines of the corresponding verbal test are shown under the pictures.

17. *Form Board and Maze Tests*

In Figure 17, the shaded forms represent depressions

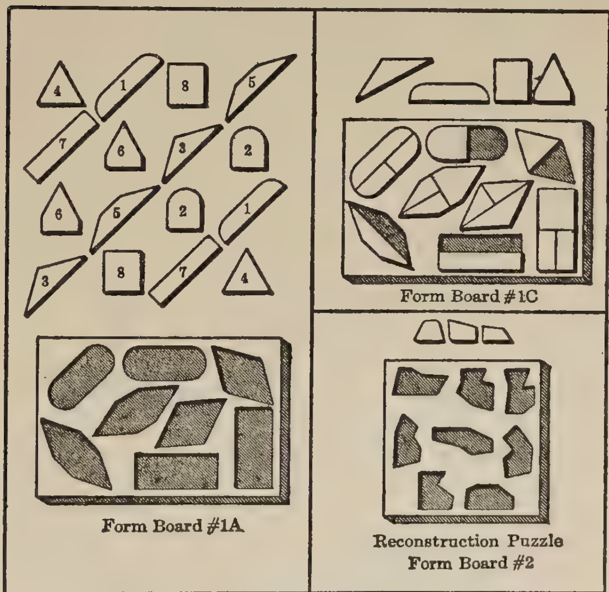


FIG. 17. FORM BOARD TESTS (Dearborn)

in a board (47). These depressions are to be filled by the blocks which are represented above the form boards. In Form Board 1C at the upper right of the chart, some of the blocks which are already placed in the apertures need to be rearranged before appropriate

openings are made for the blocks at the top of the board. Each of the depressions shown in the lower right-hand corner, Form Board 2, may be filled by the three blocks shown above them.

The maze tests were first used in psychological experimentation for testing the intelligence of animals. With the same design, they have more recently been adopted for the testing of young animals of the human type. Figure 18 is one of a series of eleven mazes

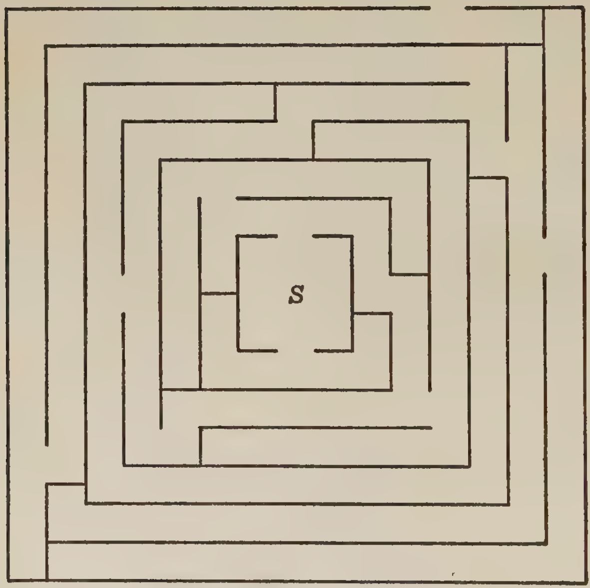


FIG. 18. A MAZE TEST (Porteus)

ranging from very simple to very complex and named the Porteus maze tests (100). The subject is sup-

posed to start at S, and to trace his way out with a pencil.

Figure 19 shows a further development of the maze test (41).[1] In the diagram marked 4, the subject is

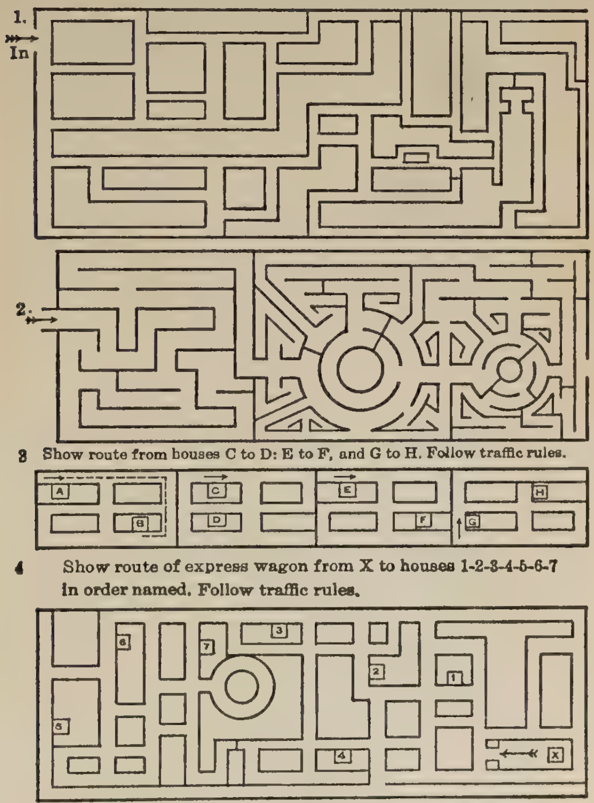


FIG. 19. MAZE TESTS (Dearborn)

[1] The Dearborn Group Tests of Intelligence, Series II, General Examination 5. Philadelphia, Lippincott, 1920.

asked to start in the direction of the arrow at X in the lower right-hand corner of the chart and trace the route of an express wagon in making deliveries at the houses indicated by the numbers 1 to 7. There are certain "traffic" rules to be followed, the chief of which are that the driver shall make no left turns and shall stop on the right side of the street. The task seems simple enough but is actually so difficult that but few adults succeed in making the "deliveries" properly even within rather generous time limits. The route is no more complicated than that imposed by the absence of left turns and the presence of one-way streets in the shopping district of Boston.

18. *Tests of Mechanical Ingenuity*

Figure 20 is a photograph of one of a series of "assembling" tests set and standardized by Stenquist as tests of mechanical ingenuity (112). The problems require the putting together, beginning at compartment A, of a monkey wrench; B, six links of a safety chain; C, three-piece Hunt paper clip; D, bicycle bell; E, coin holder; F, cloth pin; G, shut-off for rubber tubing; H, push button; I, small rim lock; J, mouse trap. A more elementary series beginning with a plain bolt and nut and ending with a nail clipper is shown in Figure 21. Another form of this test is that requiring the recognition and naming of mechanical devices.

We are thus introduced to what is to some of us

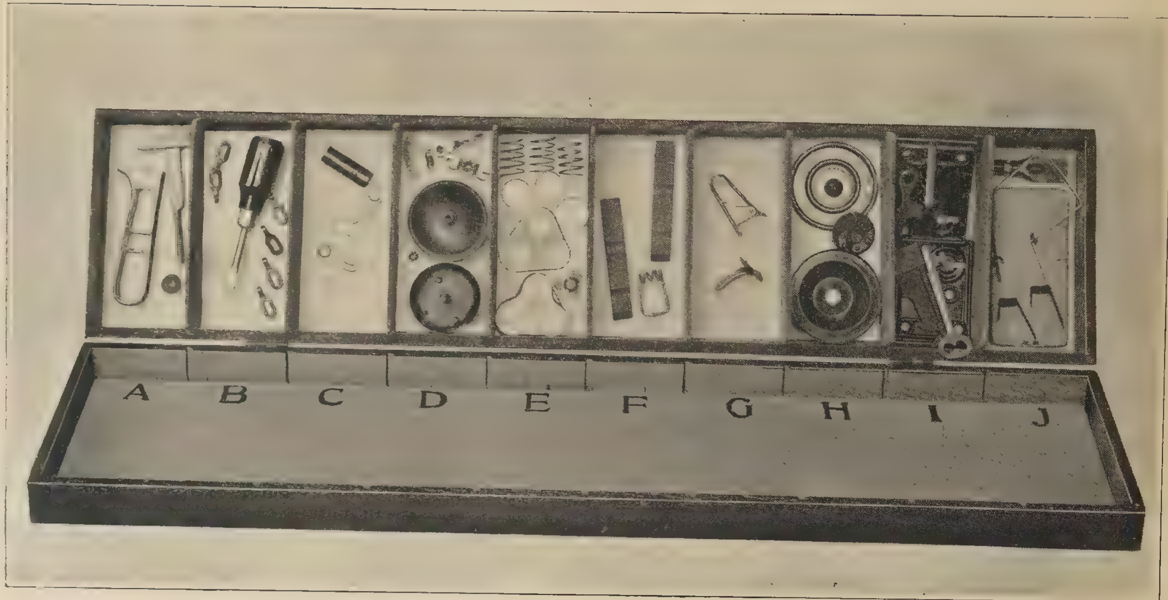


FIG. 20. THE STENQUIST TEST OF MECHANICAL ABILITY FOR THE UPPER ELEMENTARY GRADES

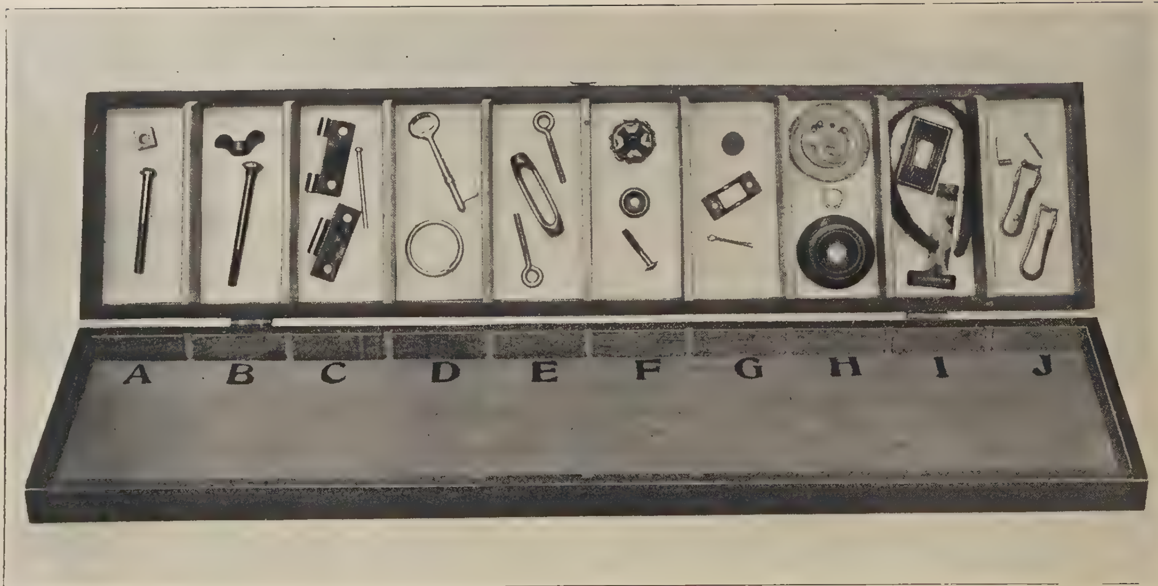


Fig 21. The Stenquist Test of Mechanical Ability for the Middle Elementary Grades

quite a different world, but one in which intelligence is also displayed. The distribution of abilities in these tasks is of the same sort and frequency as in the verbal tests. This may be seen by the frequency distributions of one of the Stenquist tests in Figure 22. The

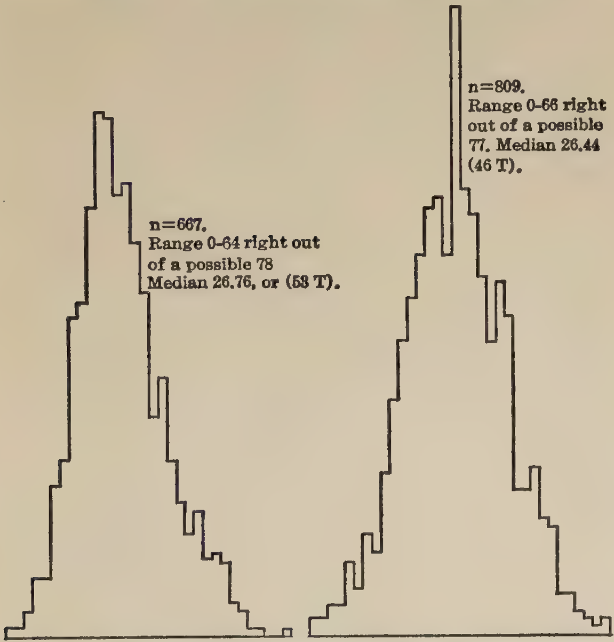


FIG. 22. DISTRIBUTION OF SCORES FOR TWO PICTURE TESTS OF MECHANICAL ABILITY (Stenquist)

tests were in this case presented as picture puzzles.

The significance of these performance tests, as they are now usually called, for a better appreciation of the existing differences in the intellectual equipment of

school children will be pointed out in the following chapter. We may now inquire what the more commonly used tests have discovered in regard to the intelligence and the intellectual development of these children.

19. *Some of the Results of Intelligence Testing*

Figure 23 shows how the children of the schools of

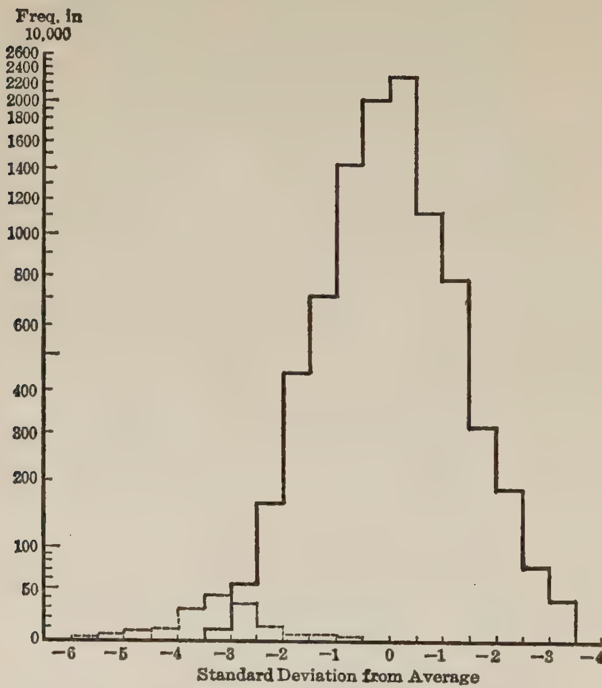


FIG. 23. DISTRIBUTION OF GENERAL INTELLIGENCE OF CHILDREN OF ORDINARY ELEMENTARY AND SPECIAL (M.D.) SCHOOLS (After Burt)

The ordinary school children are represented in solid lines, the mentally deficient in broken lines.

London are grouped as regards the amount of intelligence as determined by extensive examinations made by the English psychologist, Cyril Burt (27). The majority are possessed of a grade of intelligence which is about equally removed from that of the feeble-minded on one extreme and the genius on the other extreme. The distribution of intelligence is symmetrical and continuous; that is, there are as many bright as dull children, and of very bright as of very dull, and

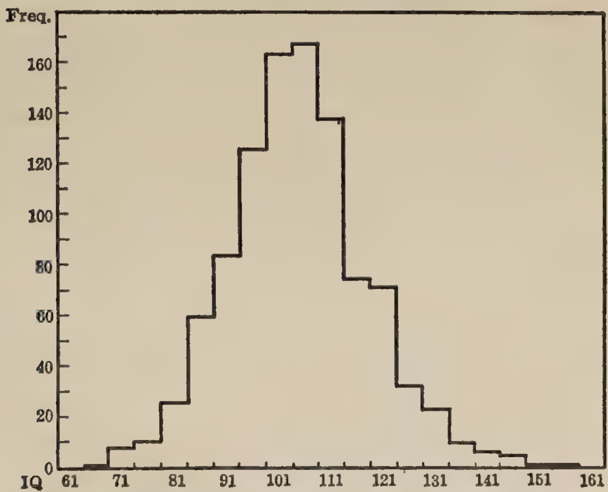


FIG. 24. DISTRIBUTION OF STANFORD-BINET I.Q.'S OF 1001 FIRST-GRADE CHILDREN (After Wentworth)

no gap or gulf separates the one division from the other. The more extreme the variation from the average on either side, the fewer are the number of cases. The proportion of the extremely deficient and

the extent of their deviation from the average are both greater than in the case of the extremely gifted.

Figure 24 shows the same facts for a thousand and one children in the first grades of suburban communities in the vicinity of Boston (136). The Binet tests were used in both studies. The range of intelligence quotients is from 56 to 146 or a total range of 90 points. The median intelligence quotient is 97.7. The group, in other words, averages about two points under the norm of 100. This is due to the retarded children in the grade, that is, those who were not promoted the previous year. When we compare all the children of a given year group, and when we are dealing with average or typical communities, the average should be exactly 100. This is found to be the case in these communities, as may be seen from an inspection of the graph at the top of Figure 25, which shows the differences in intelligence of the six-year-old children who had recently entered school. The median I.Q. is 99.8. How symmetrically the group is distributed about its median or mean may be seen from the fact that the middle half of the group is found between 93, or 7 points below, and 107, or 7 points above, the median. The total range of difference in intelligence is about 85 points. How the school copes with these great intellectual differences which are thus shown to exist between its pupils at the very start of their schooling, is a problem for discussion in a subsequent chapter. It is of interest to note that practically the same

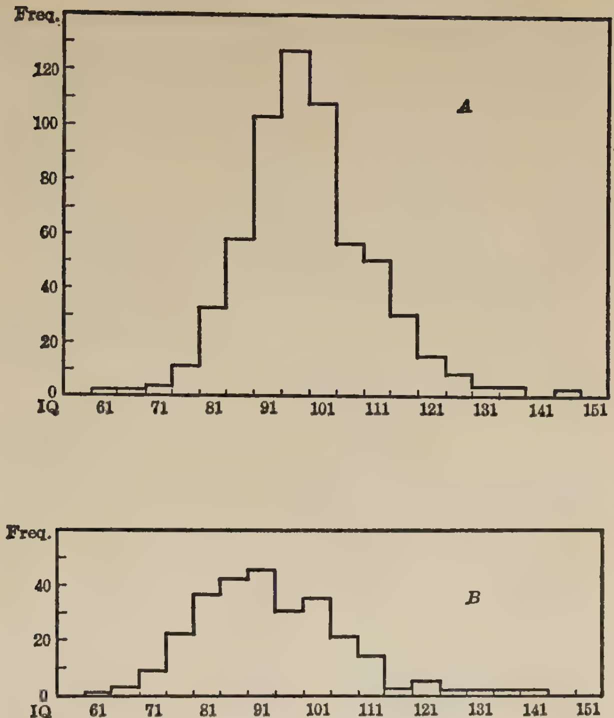


FIG. 25. DISTRIBUTION OF THE I.Q.'S OF FIRST-GRADE CHILDREN (After Wentworth)

(A) Aged Six Years (B) Aged Seven Years

range and distribution of individual differences in intelligence which were found by Burt in the regular grades of the schools of London are also found in the schools of suburban Boston.

The graph in the lower half of Figure 25 shows the distribution of the seven-year-olds in the first grade.

They are the retarded groups, the better seven-year-olds having been advanced to the second grade. Their median I.Q. is 93; 93 was the lower quartile point of the distribution of six-year-olds, which means that fifty per cent of the seven-year-olds in the first grade are equal in brightness to only the lowest quarter of the six-year-olds. This clear-cut differentiation between these year groups would ordinarily be missed by the teacher who, in estimating their intelligence, is, as we noted in the first chapter, apt to forget the differences in the ages of his pupils.

The extent of differences in mental endowment shown in the accompanying charts is best appreciated by a resort to Binet's method of comparison. Figure 26 shows the percentage of children of the various

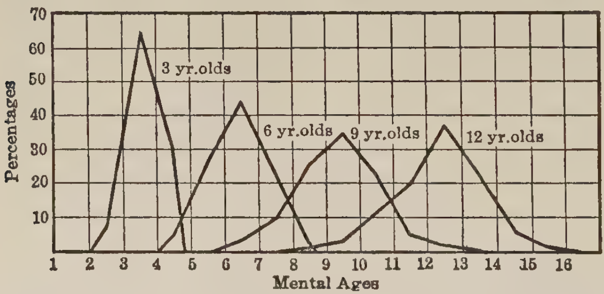


Fig. 26. Overlapping in Mental Ages of Four Different Chronological Age Groups (After Burt)

mental ages in four different life-age groups. This chart is based on the findings of Burt (27) in the London schools. The nine-year-old children, for example,

vary in mental age from less than six years to over thirteen years. The total range of differences between the nine-year-old children in the regular school grades is thus about eight mental years. If one added the nine-year-old children in the special classes for defectives and the occasional genius who may have escaped the sampling of nine-year-olds made by Burt, the range would exceed nine mental years. Among the three-year-olds, as may be seen from the chart, there are three years of mental age difference.

20. *The Range of Intellectual Differences*

If now we assume that the unit used in this comparison — that is, one mental year — is equal at all levels of the scale — that is, that the mental difference between these three- and four-year-olds is the same amount as between the nine- and ten-year-olds, we may say that the intellectual differences existing between the nine-year-olds are three times as great as between the three-year-olds. Mental-age differences are best studied at this age of nine because the scale of tests offers sufficient range to determine the extreme variations, whereas, the tests are not sufficiently extended in the upper ranges to test the extreme variations of the twelve-year-olds, and are not sufficiently reliable below age three to test the lower variations of the three-year-old. From what has been shown in regard to the variations in intelligence of the nine-year-olds, and of the ages near to nine, we may make

the generalization that the range of mental age difference varies directly with the chronological age, that is, there are approximately three years of mental age differences among the three-year-olds, four among the four-year-olds, six among the six-year-olds, nine among the nine-year-olds, and twelve among the twelve-year-olds.

These statements rest, as noted, on the assumption that one year of mental age stands for the same amount of intellectual difference at all levels of the scale. Some statistical evidence has been offered in support of this assumption for at least the middle ranges of the scale, but it is not, and probably, from the nature of the case, cannot be conclusive. In the usual description, however, of the rate of intellectual development, a different assumption has been made, namely, that development is more rapid in the early years, say up to the age of five or six, and less rapid from then on until the time of maturity when the influence of growth as a factor more or less separate from training is said to cease. In this case, the intellectual development of the average individual would be pictured by the curved line of Figure 27.

21. *The Persistence of Individual Differences in Intelligence During the Period of Growth*

Whatever the assumption in regard to the average rate of development, the decision will not affect a second important finding of the tests, namely, that the

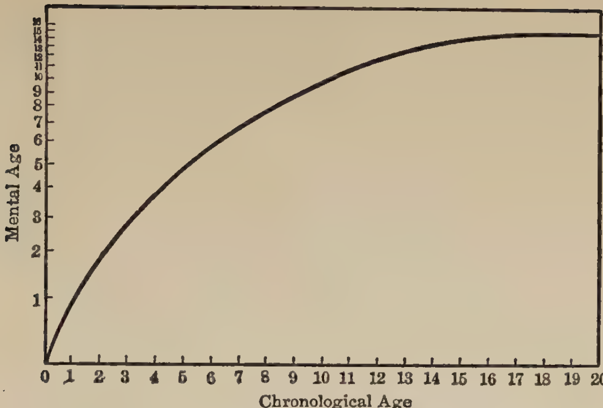


FIG. 27. THEORETICAL MENTAL-GROWTH CURVE

majority of individuals tend to follow the same general course of development as this average. This may be illustrated by the growth curves of a superior, a normal, and an inferior individual (Figure 28).

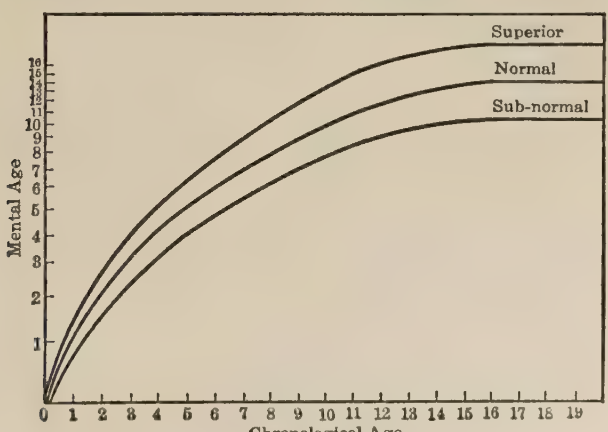


FIG. 28. THEORETICAL MENTAL-GROWTH CURVES

The same phenomenon is shown in Figure 29 but plotted on the alternative assumption that one year of mental age is *on the average* equal throughout the period of grcwth.

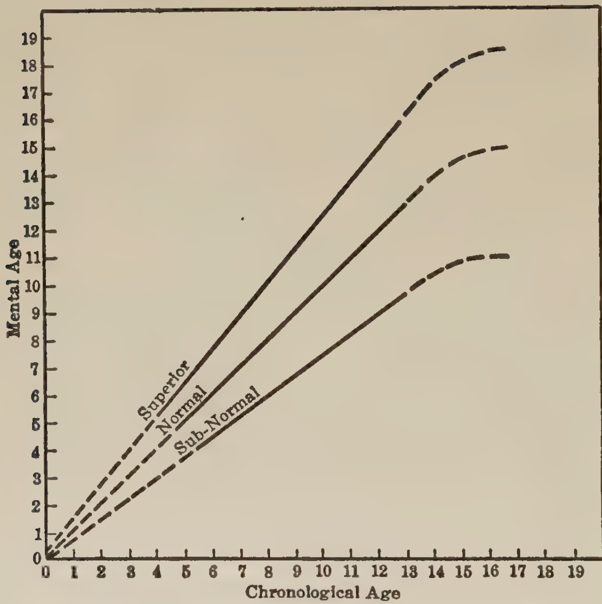


FIG. 29. THEORETICAL MENTAL-GROWTH CURVES

In Figure 30, there are shown parts of the mental-growth curves of a number of children of various degrees of brightness as determined by repeated tests (119). So far as the tests can determine, the superior individual is superior to start with, and the inferior individual inferior at the start. The inferior

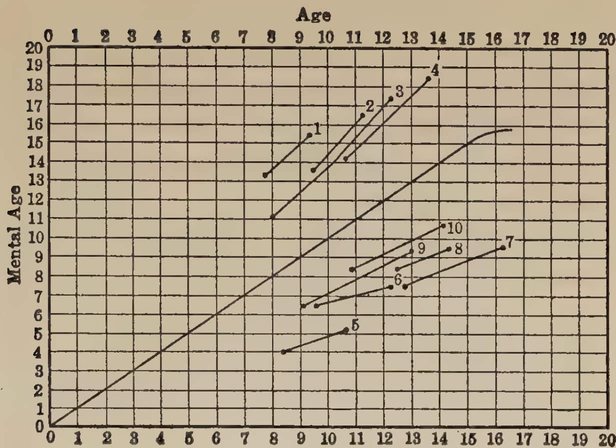


FIG. 30. INDIVIDUAL MENTAL-GROWTH CURVES OF BRIGHT AND DULL CHILDREN (Terman)

individual develops at a slower rate and reaches the period of the cessation of growth at a somewhat earlier age than the average; the superior individual develops at a more rapid rate than the average and continues his development for a somewhat longer time.

These differences in development are now commonly expressed in terms of the intelligence quotient which, as we have noted previously, is obtained by dividing the mental age by the chronological age of the individual. Repeated tests of the same individuals have shown that their intelligence quotients tend to remain constant during the greater part of the period of growth. The special importance of this finding lies in the fact that one may predict the prob-

able curve of development when the test is made in the early years of life. An I.Q. of 100 means that a child is likely to continue to grow at the average rate, one of 120 that his growth will be 20 per cent more rapid and an I.Q. of 80, 20 per cent less rapid than the average.

Similar facts, as noted, have been discovered in regard to physical development. Repeated measurements of the same individuals have shown that the boy or girl who is taller than the average at five years of age is likely to remain taller, and the one who is shorter is likely to remain shorter than the average until at least the adolescent period. At this latter period, in the case of growth in stature, there may be a considerable shifting in these relations. In how far this is true of mental development is a problem which we shall discuss in the next chapter.

CHAPTER IV

THE NATURE OF INTELLIGENCE AND THE INFLUENCE OF SCHOOLING, MATURITY AND ENVIRONMENT

1. *Definitions of Intelligence*

A recent writer has remarked that there is much more agreement as to who is intelligent than as to what constitutes intelligence. In the first chapter, we pointed out that there is a considerable amount of agreement between the judgments of experienced teachers — particularly when certain technical faults are corrected — and the results of the tests as to who are and who are not intelligent in the case of school children; but if we should ask what it is which constitutes intelligence, teachers and testers would hardly agree with each other or among themselves in their answers. In recent symposia on the subject held by British and American psychologists, many and varied opinions were expressed. Some of the briefer statements or definitions, beginning with one of Binet's, are: (1) "Intelligence is judgment, or common sense, initiative, the ability to adapt one's self." (2) According to Burt: "Voluntary attention is the essential factor of general intelligence." (3) Terman says: "Intelligence is the ability to think in terms of abstract ideas."

(4) "Intelligence is intellect plus knowledge," according to Henmon. (5) "Intelligence is an acquiring capacity," says Woodrow. (6) One of the best definitions is proposed by Ballard: Intelligence is "the relative general efficiency of minds measured under similar conditions of knowledge, interest and habituation." Other definitions are: (7) Intelligence is "a composite measure of abilities to learn" (Gates), and one proposed by Thorndike, (8) "We may then define intellect in general as the power of good responses from the point of view of truth or fact."

2. *A Pragmatic Test of the Definitions of Intelligence*

Where there are so many theories to choose from, we may well apply the pragmatic method of William James and inquire what these theories would actually do if reduced to practice, and we shall find that they would do much the same thing. They would agree, for the most part, in doing what the Binet tests do and what presumably the common man does when he forms an opinion of another's intelligence. This is neatly illustrated by the discussion of the nature of intelligence in Professor Spearman's recent book (109). Professor Spearman shows to his own satisfaction that Binet's theories about the Binet tests were the very opposite of what they should be in view of what the tests actually are and do, and that the Binet tests are exactly what are called for by his own (Spearman's) theory of the nature of intelligence. It, of course,

hardly needs to be pointed out that Binet thought his own tests the concrete embodiment of his own theories.

3. *Spearman's Views and his Criticisms of Binet's Concepts of Intelligence*

Professor Spearman's argument runs as follows (109):[1] Binet states to begin with (to quote the substance of an early statement) (18)[2] that almost all the phenomena with which psychology occupies itself are phenomena of intelligence: a sensation, a perception are intellectual manifestations as much as reasoning is. He then inquires: ought we to allow the measure of sensation to intervene in our examinations, and replies to his own question: No! it would be a great loss of time because there is in intelligence one fundamental organ or agent, namely, judgment. A person without judgment may be feeble in mind or an imbecile, but with good judgment he can never be so. Memory is also distinct and independent of judgment. This doctrine, to Spearman's mind, implies a formal power, possessing a unitary nature and is quite different from Binet's practice in that "more than half the tests actually employed . . . diverge intentionally into the very powers just rejected, that is to say, sensory and memorial." In fact, in another article Binet speaks of three categories

[1] From *The Nature of Intelligence and the Principles of Cognition*, pp. 9, 10. By permission of The Macmillan Company, publishers.
[2] From *Année Psychologique*, xi, 1905, pp. 195–97.

of tests: (1) of memory, (2) tests of intelligence done partly by the help of language, and (3) tests of sensorial intelligence. But, says Professor Spearman, "these categories are not considered separately"; "all are at once thrown quite promiscuously into one single pool." This promiscuous 'ducking' appears to Spearman "irreconcilable with their (Binet and Simon's) theoretical exposition or with any theory whatever of unitary formal powers."

Four years later than the date of the article above cited, Binet defines "intelligence in a completely different manner." "Comprehension, invention, direction, and censorship, intelligence lies in these four words."[1] To Spearman "there are now involved not one but four believedly independent powers." The tests cannot measure all four, "the better it fits any one of them the less well can it fit the others." Professor Spearman's amazement reaches its climax "when a single one of them, invention, although declared to be primordial is, on the very same page, analyzed into a crowd of faculties" including "memory, imagination, judgment, and especially language," and he concludes that Binet "can nowhere find a theoretical perch satisfactory for a moment even to himself." Professor Spearman concludes then in these words: although Binet and Simon believed that their tests "measured some genuine 'intelligence,' consisting in one or more formal powers, nevertheless in

[1] Cited from *Les idées modernes sur les enfants*, 1909, p. 118.

their actual practice [they] had totally abandoned this theory in favor of the opposite one of Two Factors" — which is Spearman's own theory. "To this complete, however unconscious practical recantation their extraordinary triumph would appear to have really been indebted." Thus from his own lips we have it that Spearman had the right theories, and Binet the right methods. This, after all, is more agreement than we might at first have anticipated.

Professor Spearman's theory is that in any intellectual operation, such as adding a column of figures or of translating a passage of French into English, there are two factors involved: first, the specific skills or abilities as of arithmetic and language, and a general ability which is common to all the specific abilities, a sort of common fund of intellectual energy. It is this common factor, which others have called general intelligence, which explains the positive correlations between the special abilities. If a person is good at one thing as, for example, mathematics, the rule is that he is apt to be better than the average in other intellectual traits as, say, in linguistic attainments.

We have decided to discuss this matter from the standpoint of practice rather than theory, but it is interesting to note in passing that commentators have pointed out that there is in Binet's definition of intelligence as a fundamental faculty or agent the same assumption of a sort of common factor which Spearman has posited as a result of his statistical studies (141).

4. *A Corollary of Spearman's Theory*

The practical corollary of Spearman's theory which — also as we have seen — explains for him the success of the Binet method is phrased by him as follows: . . . by *pooling* a sufficiently large number of any diverse cognitive operations whatever, the general factor can always be brought as nearly as desired to sole influence. For each specific factor, since in such pooling it occurs only once out of many times, must necessarily become of correspondingly insignificant weight. Conversely, the general factor, since it occurs every time, must in the end become paramount. But if that be so, then *any* two such extensive pools will arrive at approximate accordance with each other. And should one such pool be obtained for any person by means of tests, it must accord more or less well with the ordinary estimate that any other person forms of him, since this estimate is likewise of the nature of a pool, although derived from quite different data.[1]

This hypothesis would then explain the agreement above noted between teachers' judgments and that of other capable observers and the findings of the testers.

5. *Opposing Theories*

If, however, we proceed on just the opposite theory, which was at one time advocated by Professor Thorndike (123), we can find an equally good explanation of the success of the present intelligence test. According

[1] *Op. cit.*, p. 6.

to this theory, which was doubtless at no time held in quite the extreme form in which it is here stated, the specific abilities which an individual possesses are not related by any common factor or in any other way, but each is "rigorously independent." There is, strictly, no such thing as a general intelligence, but only a lot of special and unrelated intelligences and skills. Even so, we might strike an average of the various special abilities, which would enable us to say that on the average this person has a higher level of special abilities than another person.

We reached the same conclusion (in the preceding chapter) in connection with our description of what the tests do. Defining intelligence, as many have done, as the ability or capacity for learning, we then noted that, for practical reasons, the tests in common use are not tests of the actual process of learning but are tests of what has been learned. The assumption is made that if one samples the results of learning in matters where all the individuals tested have had an equal chance at learning, he may arrive at an estimate of the capacity to learn. But since it is difficult to find even simple experiences which are common to all individuals of a given age period, actually, again, one tries by sampling a large range of fairly common experiences to strike an "average" which, despite the fact that a given individual may have missed this or that experience, will still be representative of the individual's learning.

Thus we see that, whether we adopt the theory of two factors, or the theory of more specialized abilities, or whether we define intelligence rather vaguely as the ability to learn, we reach much the same practical conclusion. By pooling a sufficiently large number of cognitive operations, the general factor (or general intelligence) becomes paramount; by averaging a large number of the special abilities of different individuals, we may compare their average intelligences, or by sampling a large range of fairly common experiences we may again, by striking averages, secure results which will be representative of the learning of different individuals.

Thus a pragmatic test would seem to discover no significant differences in these various formulations regarding the nature of intelligence. If, however, one seeks a more adequate description and analysis of the concept he may find it, as it has appeared to the writer, in a consideration of the relation of intelligence to learning (42).

6. *An Analysis of Intelligence in Terms of the Learning Process*

In the most elementary form of learning, that by "trial and error," the various possible responses in a given situation must actually be tried out overtly until the right or suitable response is found; in the highest form of learning, that of reasoning, the outcome of some of the various courses of action is, as a

result of previous experiences, anticipated in thought and is ruled out without the necessity of trial.[1] Thus if one man can by taking thought anticipate the consequences of at least some of the incipient responses which are aroused in a given situation and needs actually to try out only a limited number or make but a single response, he will be regarded as more intelligent, at least in the given situation, than another who can anticipate the consequences of none of his acts and must needs blindly try all of the ways which occur to him. Professor Thurstone has recently given an illuminating account of this withdrawal of the trial-and-error process from without the organism as overt action, to within the organism as thought, and has proposed as an index of an individual's intelligence the extent or completeness of this recession. He considers "the main characteristic of intelligent conduct" to be "the transfer of the trial-and-error point from overt alternatives to percepts, from percepts to the still more tentative ideas, and from ideas to the still more approximate actions that we know as concepts," and defines intelligent conduct "as a trial-and-error process which takes place at that stage of our life impulses at which they constitute incomplete and approximate action." Conceptual intelligence he regards as "this same process of verification and selection among alter-

[1] This is the thesis of Ernst Mach. See "Über Gedankenexperimente" in his *Erkenntnis und Irrtum*. Leipzig, 1906. I am indebted to my friend Dr. Edwin B. Holt for this reference.

natives that are not even bodily or spatially defined and that have not yet been particularized by the expected environment," and abstract thinking as "this trial-and-error process carried on with impulses that are as yet only symbolic of types of experience, unfinished, loosely specified and flexible indices of expected conduct" (130).

7. *Intelligence as Related to Experience*

The stage at which the trial-and-error process operates, whether in the percept, in the concept, or in abstract thinking, should, however, be determined only with reference to materials on which the mind has worked. It is by the accumulation of experiences that the gap between overt trial and error and that which takes place in thinking is bridged. Since differences in experience make for differences in intelligence, the nature or character of the individual's experience must also be taken into account in the testing of his intelligence. These facts require further consideration.

Knowledge of the environment (as well as of conditions within the organism) is acquired first through responses to features or elements which in themselves have significance for the organism, the so-called unconditioned responses, and, secondly, through responses to those features or elements which have gained significance from having occurred with the former as parts of the total situation, the so-called conditioned responses. The establishment of the latter

responses to conditioning stimuli has been taken as marking the beginnings of intelligence. Knowledge, however, from both these sources makes for differences in the intelligence of individuals. In appraising intelligence one must, therefore, take account both of the character and perhaps the number of the elements or properties of things which the peculiar needs of the organism isolate or abstract through its senses and, secondly, of the number and kind of elements or attributes of things which have gained significance, or have become of interest to the organism, by being associated with these first-named elements.

8. *Association by Contiguity and by Similarity*

These associations in the more traditional descriptions were said to be of two sorts: association by contiguity (in time or space), and what was regarded as the basis of more intelligent behavior, association by similarity.

Association by contiguity describes the method of habit-formation and is the more elementary principle of learning. A new stimulus, new in the sense that it has hitherto been insufficient or inadequate by itself to arouse a given response, may in time arouse this response solely as a consequence of its having occurred along with the adequate stimulus. Whereas in association by similarity the response in the second instance is provoked by the same elements or element as first provoked it. The situations producing the

response are partially identical; there are certain elements common to the two situations, oftentimes quite incidental ones, which have, however, all along been capable of producing the response in question. On the other hand, it is also evident that in association by contiguity the hitherto inadequate stimulus was part of the pattern of an earlier experience as it is subsequently, as an "adequate stimulus," a part of the more recent situation. So we may note that the process by which a former experience is recalled or reintegrated is the same in both forms of association. Its recall or reintegration is due to the existence in the present experience of some element or phases identical with those of a past experience. The difference is, then, not one of process, but of the *elements* or aspects of things to which the individual responds, and the elements to which he responds are in the first instance determined, as noted, by the practical needs, the appetites and interests of the individual as well as by his sensory and motor equipment.

9. *The Criteria of Intelligence as Seen in the Interpretation of the Behavior of Animals*

The importance of these considerations for the appraisal of human intelligence may perhaps be better appreciated by reference to their significance in estimating animal intelligence. If my dog has been shut up for long in the house, the sight of the open door is an adequate stimulus for his going out. If, however,

since his egress usually depends upon me, he should show no interest in my acts until I actually turn the knob of the outer door, I should regard him as less intelligent than if he anticipates the pleasure of a walk with me from the moment I take down my hat or coat or put on my rubbers. His anticipations are possible because of associations by contiguity. If, on the contrary, he bestirs himself every time I light my pipe or get up to take a book from my shelves, rather than takes these acts as indications that he had better prolong his nap, I should regard him as stupid, for the reason that these acts have not been the usual precursors of my leaving the house. If, further, and assuming for the sake of the illustration that I am a systematic person, my dog should arouse himself on the stroke of the hour, this would be considered a nice bit of abstraction on his part, but still to be classified under the rubric of contiguity in time and space. What more is required of him to reach the height of intelligent behavior, and in this instance, as it happens, wrongly required of him, may be seen by recalling a familiar illustration of James's.

In commenting, in his chapter on "Reasoning," on the story of a dog who had been sent by his master to the house to fetch a sponge to mop out a boat full of water, and who actually brought one back, James remarks that, if unable to find the sponge at the house, the dog had brought back a dipper or a mop instead, this would be considered an act of reasoning. "Such

a substitution would have shown that embedded in the very different appearances of these articles, he had been able to discriminate the identical attribute of capacity to take up water and had reflected, 'for the present purpose they are identical'" (73).[1] Such sagacity would indeed have evidenced the possession of conceptual intelligence — that is, of the possession of the highest type of intellect. It is at this point that we may draw the moral of our earlier remarks in regard to the necessity of taking account of the peculiar contacts of the individual with the properties of things in an appraisal of his intelligence. The capacity to take up water is not an aspect of things in which the dog has had occasion to be interested, except as he may have observed his own capacity. Had he essayed the *drinking* of the boat dry, this response would needs be regarded as quite as intelligent as if he had brought a mop or a dipper. Whether the animal is capable of forming associations by similarity cannot be determined by such tests as these. If the "most prosaic of human beings could be transported into his dog's mind," as James proposes, it might not be "the absence of fancy at which he would be appalled," but at the lack of *his* fancies there. Sunsets might suggest not "heroes' deaths, but supper time," but what of the similars of smell?

The properties or attributes of things also are

[1] *The Principles of Psychology*, vol. II, by Henry James. New York, Henry Holt & Co.

learned by what the individual does to them, and these reactions are, as above noted, determined by his motor equipment. The futility of setting problems requiring the handling of things on the part of animals without hands is evidently as great as setting problems which bear no relation to the instinctive life of the animal. The recent advances in animal psychology have been possible because of a recognition of these factors (77).

10. *Standards for Appraising the Human Intellect. The Relations of Language to Intelligence*

Although the structural differences as between humans are incomparably less than as between animal and humans, yet, because of such differences as they possess, they too form different conceptions of the "properties and attributes of things" for which allowance must be made in the choice of materials by which their intelligence is tested. Here also the setting-up of a criterion in terms of the nature of the intellectual process or of the stage at which it operates, without reference to the content of the individual's experience, will lead to false conclusions about the intellects of some of the subjects tested. There is, for example, a tacit assumption on the part of some psychologists and an expressed assumption on the part of others that, except by the use of words and numbers, conceptual intelligence and abstract thinking cannot be tested; that non-language tests, in the nature of the case, require

little or no abstraction, and that the preponderance of linguistic and numerical tests in the present instruments for testing intelligence is therefore justified.

The question at issue may be stated more broadly in the terminology employed in the earlier part of this chapter: Do the Binet tests and other tests which have been constructed in the same manner actually *pool* a sufficiently large number of cognitive operations, or sample a sufficiently wide range of special abilities and individual experiences? The answer is that they do not: the pooling or sampling is too largely of linguistic and scholastic operations and attainments. There is a further aspect of the matter which we are now in a better position to discuss: namely, the contention that the linguistic limitation is necessary if we are to test the higher cognitive operations — those which require abstract ideas or conceptual thinking.

Professor Terman (120) has so contested with much vigor. His argument is, in part, as follows:

> Many criticisms of the current methods of testing intelligence rest plainly on a psychology which fails to distinguish the levels of intellectual functioning or to assign to conceptual thinking the place that belongs to it in the hierarchy of intelligence. If an intelligence test can be shown to depend upon the language factor (i.e., upon the ability to think in terms of symbols), this is sufficient in the eyes of some psychologists to condemn it as non-valid. The subject who cannot acquire a normal vocabulary, see the point of a fable, or be taught to read a paragraph with understanding is considered to have demonstrated his intelligence if he can trace a simple maze or assemble the fragments of a form board. In fact the "idea thinker" is sometimes spoken of dis-

paragingly or even a little contemptuously, particularly in the case of a child whose superior ability in this respect places him in a conspicuous contrast with other children of the same age.

But if intelligence is the ability to think in terms of abstract ideas, we should expect the most successful intelligence tests to be just those which involve the use of language or other symbols. We should also be justified in demanding that an intelligence test should correlate well with what we may call "school educability." As a matter of fact, it is precisely tests of this type which are surviving in the struggle for existence; tests involving arithmetical reasoning, language completion naming opposites, matching proverbs, completing analogies, understanding difficult passages, etc. . . .

With this conception of intelligence we can understand why it is so difficult to devise tests of the non-verbal or "performance" type which will bring out intellectual differences much above the level of the average child of ten or a dozen years.

To this statement, we should reply that it is as yet too early in the history of the development of intelligence tests to rest the argument on the "survival of the fittest" and the question is not, for example, whether a child cannot acquire a normal vocabulary or is not possessed of "school educability," but whether he has had a fair chance and opportunity for such acquisitions so that his intelligence can properly be gauged by them, or whether his intellectual development has taken some other course and must therefore be tested by some other means.

The reason why it has been so difficult "to devise tests of the non-verbal or 'performance' type which will bring out intellectual differences much above the

level of the average child of ten or a dozen years," may be due to the fact that the verbalist and the scholastic have hitherto been the ones chiefly interested in the development of intelligence tests, and they have naturally chosen tests in the use of which their own intellectual powers will not suffer by comparison.

11. *The Intellect when Dealing with Things Rather than the Symbols for Things*

The following account by H. H. Turner (55) of a great discovery may be taken as an example of thinking in terms of things rather than in terms of the symbols for things, as, in fact, an example of a non-verbal or "performance" type of intelligence test, and one which required for its mastery an intelligence above the level of the average child of ten or a dozen years.

Our knowledge that light had a finite velocity followed on the invention of the telescope and the discovery of Jupiter's satellites: the news of their eclipses came late at times and these times were identified as those when Jupiter was unusually far away from us. But the full consequences of the discovery were not realized at first. One such consequence is that the stars are not seen in their true places, that is, in the places which they truly held when the light left them (for what may have happened to them since, we do not know at all — they may have gone out or exploded). Our earth is only moving slowly compared with the great haste of light; but still she is moving, and consequently there is "aberration" — a displacement due to the ratio of the two velocities, easy enough to recognize now, but so difficult to apprehend for the first time that Bradley spent two years in worrying over the conundrum presented by his observations before he thought of the solution. It came to him unexpectedly, as

often happens in such cases. In his own words — "at last when he despaired of being able to account for the phenomena which he had observed, a satisfactory explanation of them occurred to him all at once when he was not in search of it." He accompanied a pleasure party in a sail upon the river Thames. The boat in which they were was provided with a mast which had a vane at the top of it. It blew a moderate wind, and the party sailed up and down the river for a considerable time. Dr. Bradley remarked that every time the boat put about, the vane at the top of the boat's mast shifted a little, as if there had been a slight change in the direction of the wind. The sailors told him that this was due to the change in the boat, not the wind; and at once the solution of his problem was suggested. The earth, running hither and thither round the sun, resembles the boat sailing up and down the river; and the apparent changes of wind correspond to the apparent changes in direction of the light of a star.[1]

With such an illustration in mind it is clear to see that what may from the standpoint of the materials used be spoken of as a highly developed mechanical intelligence may, from the standpoint of that which is done to and with the materials, be considered a highly developed abstract intelligence. It has been easier to develop tests of the use of language and of numbers because they enter more commonly into the experiences of the individuals who are now making the tests, but the "thing-thinkers" also make their contribution to the sum total of human attainment, and could also supply some suitable intelligence tests, if their services were once enlisted.

[1] By permission of Cambridge University Press.

12. *Kinæsthesis and the Materials of the Intellect*

The intellectual differences at issue and the methods of testing them may even be traced a step farther back to individual preferences (possibly in part innate, but more probably in large part the result of environment and training) for the various forms of sense material or knowledge, especially as between that of the, as often described, "higher" senses of sight and hearing and the "lower" muscular or kinæsthetic senses. It may well be questioned whether the kinæsthetic should be classed with the senses of smell and taste and whether it is not a peer of sight and hearing in the intellectual development of some individuals.

As Professor Pear has observed, few people realize that kinæsthetic knowledge may form a basis for conceptual thinking. Although the motor-minded may rightly be classed with the "idea-thinkers" — to recall Professor Terman's term and his complaints as to the treatment of the idea-thinkers — the motor-minded, in turn, meet with disparagement at the hands of the better recognized members of the group. Professor Pear (97) describes the situation thus:

> The tradition that knowledge worth having is almost exclusively confined to that which has reached us through our eyes and ears has been confirmed and hardened by the powerful mechanisms of class distinction and class tradition, and by generations of a certain type of teacher in school and university. To such influences, the ordinary man owes his view of culture. From most people, therefore, the motiles, as compared with their socially established brothers, the visiles and audiles, seldom get fair play. The two latter

groups, themselves recognized as belonging to a kind of intelligentsia, not infrequently fall into the bad habit of regarding with some contempt all persons whose motor activity is expressed through channels other than the socially approved ones of speech and writing.

In a footnote to this passage, Pear cites the "suspicion" of Bertrand Russell that what people mean by intellect is simply "certain habits in the use of words" and Russell's lack of "mystical reverence for these habits" (107).

13. *Verbal Intelligence and Collegiate Attainments*

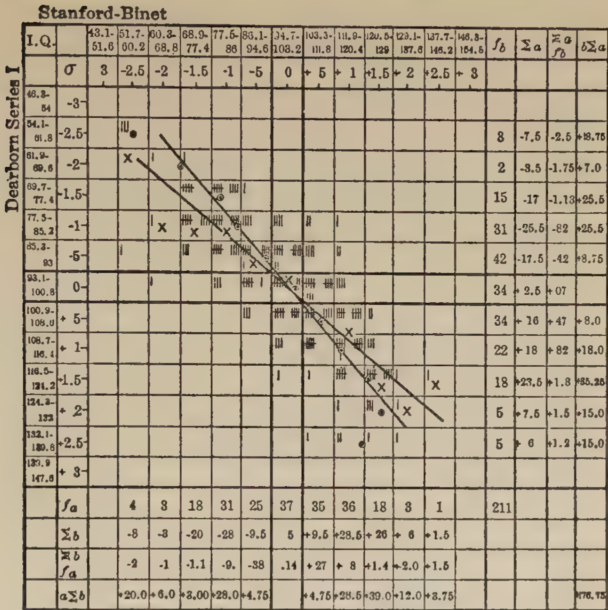
Without dwelling further on these mutual disparagements and misunderstandings, we may return to our argument: Abstract thinking is not confined to the use of auditory and visual symbols. If, therefore, the materials of the tests are so limited, the intellects of an important section of the population will not be properly gauged. The difference noted in the second chapter between the college marks of students who subsequently become college professors, and more particularly professors of languages, and the college marks of students who subsequently became eminently successful in business may be recalled in this connection. The professors of language stand at the peak of eminence in the literary-academic intelligence which our present intelligence tests chiefly measure, surpassing even their professional colleagues in other fields of learning. The professors of physics and chemistry above referred to and the business men, it need

hardly be said, are not altogether lacking in this type of intelligence, nor are the professors of language altogether without other kinds of intelligence. There are no such clean-cut demarcations, and, of course, other factors complicate the analysis; but a difference in kind of intelligence is one factor which enters into the explanation of these findings. The college may or may not be well advised in preferring one type of intellect, but tests which purport so to sample the different specializations of the mind that comparisons may be made of individual differences in intellectual power cannot, in all fairness, be thus partial. If, in place of the teacher, the psychologist, and the psychiatrist, who have been the creators of our present intelligence tests, a group of skilled artisans, engineers, manufacturers, bankers, mathematicians, physicists, astronomers, musicians, sculptors, surgeons, etc., should seriously undertake the devising of a series of intelligence tests, the narrowness and specialization of current methods of estimating intelligence might well be demonstrated.

The performance tests discussed in the last chapter are admittedly but crude beginnings, but even they can point to some specializations of intelligence. These differences are naturally less marked at the beginning of schooling, if, as noted, they are matters of *nurture* more than *nature*.

14. *Intellectual Types as the Effects of Schooling*

Figure 31 shows the correlation in the standing of



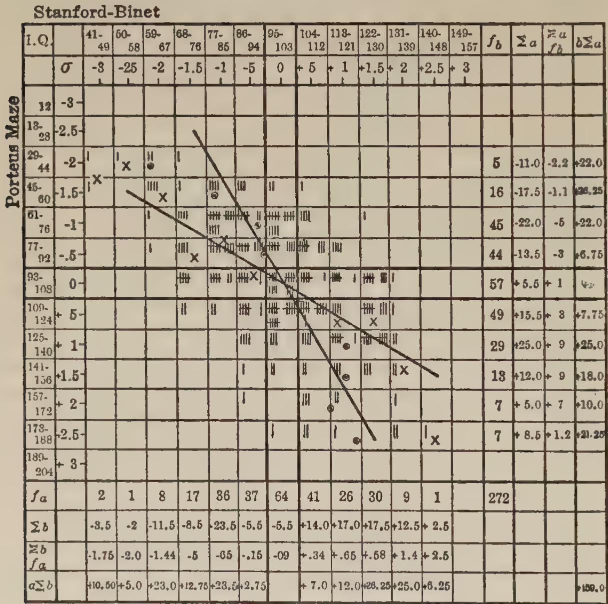
$\text{Mean}_{s\text{-}b} = 99$ $\quad \sigma_{s\text{-}b} = 17.2$ $\quad r = \frac{\Sigma ab}{N} = \frac{176.75}{211} = +.84$ $\quad r\frac{\sigma y}{\sigma x} = .754$

$\text{Mean}_{D} = 97$ $\quad \sigma_{D} = 15.5$ $\quad \text{P.E.} = +.014$ $\quad r\frac{\sigma y}{\sigma x} = .93$

FIG. 31. CORRELATION BETWEEN STANFORD-BINET AND DEARBORN I.Q.'S (Rand)

first-grade children in a group-performance test (samples of which are shown in Figure 15 between pages 74, 75) and their standing in the Binet tests (103). If there were perfect correlation, the two oblique (or regression) lines would form one line and all the individual check marks would fall on this line. That there is a considerable amount of agreement may be seen from an inspection of the chart. The Pearson Coefficient of Correlation

is + .84, which is fairly high in view of the many factors which may make for a lack of agreement in the standing in any two tests. In fact, this is as high an



Mean$_{\text{S-B}}$ = 99 $\sigma_{\text{S-B}}$ = 18 $r = \frac{\Sigma ab}{N} = \frac{159}{272} = +.58$ $r\frac{\sigma y}{\sigma x} = 1.03$

Mean$_{\text{P}}$ = 101 σ_{P} = 32   P.E.$_r$ = +.027 $r\frac{\sigma x}{\sigma y} = .33$

FIG. 32. CORRELATION BETWEEN I.Q.'S DETERMINED BY THE STANFORD-BINET AND BY THE PORTEUS MAZE TEST (Rand)

agreement as is frequently found between two *forms* of what is intended to be exactly the same test. At the beginning of school, then, the difference between the abilities tested is not large. A wider spread of the lines and check marks is shown in Figure 32 (103), indicat-

ing less correspondence in the two kinds of ability tested. The subjects are again first-grade children.

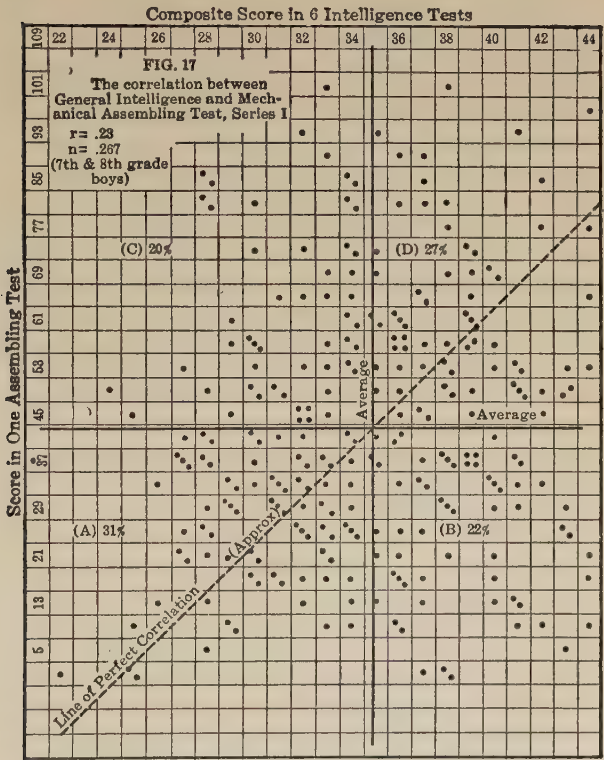


Fig. 33. Correlation between General Intelligence and a Mechanical Assembling Test (Stenquist)

The abilities compared in this case are those required by the Porteus Maze tests (compare Figure 18) and by the Binet tests (103). The coefficient of correlation

is + .58. A good many more children, thus, do differently in these tests than in the first two compared. But those who do alike in the two tests still outnumber those who do differently.

Figure 33 shows the practical absence of relation between the standing of boys of the seventh and eighth grades in a group of more or less verbal and scholastic intelligence tests and their standing in the Stenquist mechanical ingenuity test (112). These comparisons suggest what it will need more evidence to prove, namely, that the effect of the ordinary schooling is to widen the gap which is but scarcely observable at school entrance between the two sorts of ability compared.

15. *The Findings of Burt and Gordon on the Relations of Schooling and Intelligence*

More direct evidence is available as to the effect of schooling on the sort of intelligence which our currently used tests measure. Burt (27), by the use of partial coefficients of correlation, estimates that over one half of the gross result is attributable to school attainment, and that "linguistic ability and linguistic attainments exert upon the Binet-Simon tests a special and positive influence of their own." [1] Burt's

[1] A repetition of Burt's experiment by one of the writer's students, F. S. Freeman (54), finds the possible influence of schooling less than in the case of the original experiments. He notes that Burt's method of stating his results in terms of proportions or percentages is open to criticism and that, in the interpretation of what is cause and

statistical analysis of the effect of schooling on the test results finds support in another and more recent English study by Gordon (57) of physically defective, gipsy, and canal-boat children of little and, in some cases, no schooling.

Gordon shows that the intelligence, as tested, depends as much upon the amount of schooling as does the educational attainment. The correlation between the mental ratios, or intelligence quotients, and the amount of school attendance is exactly the same as between the educational ratios and school attendance. He also finds a high correlation between the educational ratios or relative educational attainments and the mental ratios or relative mentality.

Particularly impressive are the comparisons in the case of the English canal-boat children. These children "in respect to health, cleanliness, morality, feeding, etc., are fully equal, if not superior, to town dwellers of a similar character. That they are not mentally defective, as is generally understood by that term, is shown by the life and wages of their parents, who in many cases have had no education and can neither

what effect, it is "just as reasonable to conclude that successful performance on the Binet and successful school work are dependent on similar elements and hence success in one is likely to indicate a fair amount of success in the other." Even so, there is nothing in these statements or findings to gainsay the equally probable hypothesis that the amount and quality of school work contribute to the standing in the Binet tests. See also the discussions of Holzinger and Freeman (68), and Thomson, *Journal of Educational Psychology* (122).

read nor write. Their intellectual life as judged by ordinary standards, is of a most meager description, owing to their lack of education and to their social isolation."

The schooling of these children is negligible. The average attendance at school is estimated as about four to five per cent of the school year as compared to the average of 88 per cent for ordinary elementary-school children. The rank correlation between the intelligence quotients, as determined by the Stanford Revision of the Binet tests, and the chronological age of these children, the oldest child being ranked first, was $-.75$. This inverse correlation means that the older a child is in life age the duller he is in mental age. The children of six years of age or less had intelligence quotients between 90 and 100, that is, according to the tests, they were all of average intelligence at this age, whereas with but one exception the children over nine years of age had intelligence quotients of .70 or below; in other words, as far as the tests go, the older children who were tested were with one exception adjudged feeble-minded. The older children in the same family were, relative to their life age, less intelligent (in the tests) than the younger children.

Similar findings are reported for the tests on gipsy children.

There seems but one possible explanation of these findings: The reason the younger children do better in the Binet tests is that success, in the tests for the

very early years, does not depend upon schooling and but little on the ordinary cultural environment, and the failure of the older children is largely due to the fact that the tests for the higher ages do require schooling and some culture.

In commenting upon his investigation, Gordon writes: "The important question suggested by these results is whether there is any mental development apart from the mental effort and such mental exercises as are generally associated with school life"; and he concludes that the answer "probably depends on the social environment of the children." In a series of rather elementary performance tests, (47) we have found that ordinary school children do not improve much after the age of nine. This result is doubtless due, in part, to the fact that these tests are not extended sufficiently to test increasing skills. It may also be in part due to the fact that the training of the schools has not improved the abilities tested by the performance tests. Contrawise, children with little or no schooling, according to Gordon's results, advance but little with age in the Binet tests. Would they show greater improvement with age in the performance tests? Gordon hazards the opinion that "The gipsies might do better but not the canal-boat children," and points to the value of an investigation "by means of specially devised environmental tests of possible mental development in other directions than those tested by the Binet tests."

16. *Temporary and Permanent Differences in Intelligence Due to Differences in the Rate of Physiological Maturing*

There remains another factor whose effect we must attempt to isolate and measure if we are to appreciate the nature of intellectual differences, namely that of the relative rates of maturing. We have already noted in the previous chapters that the rate of development, as indicated by the constancy of the intelligence quotient, appears to be fairly uniform for the majority of individuals, provided their development takes place under similar conditions of environment and training. There are individual exceptions to this rule during the earlier years of growth, and there is presumptive evidence in the studies of physical growth that the exceptions to the rule may increase during the adolescent period. Mental tests have not as yet been repeated on sufficient numbers of individuals at this period to determine this matter, nor have the causes of individual variations during the earlier years been sufficiently studied.

Severe illness and social isolation may sometimes account for retarded development; a process of "hot-housing," which is sometimes resorted to by over-ambitious parents, may produce at least temporary acceleration in development. In others, the cause appears to be inherent. As Cyril Burt (27) has said in speaking of children whose growth has been retarded:

Such children are creatures of deferred maturity. Their development is not arrested; it has been postponed. Although upon a lower plane, their mental growth runs parallel with that of many cleverer children, in whom the phenomenon is more familiar. There is many a sharp child whose cycle of growth is like that of the mulberry tree, presenting first a long delay, and then a sudden yield of flower and fruit together. Their existence is recognized in the double scholarship examination. In London, at the age of thirteen, a second examination has been instituted specifically for those who in the current phrase "bloom late," and whose anticipated powers, therefore, do not ripen by the age of ten. In like fashion, among classes of defectives, time and due season will here and there disclose a sporadic "school autumnal."

In how far these peculiarities in mental development may depend on the corresponding changes in the general physical or physiological development is a question the answer to which must probably await a study of a sufficient number of individuals by means of both physical and mental tests repeated at regular intervals throughout the whole period of growth.

17. *The Harvard Growth Study*

Such a comprehensive investigation was begun in the fall of 1921 at Harvard University with the aid of a subvention of the Commonwealth Fund. Over three thousand first-grade children were examined with a series of mental, physical, and scholastic tests with the intention of repeating these measurements annually on the same children or on as many of them as remain in school, over a period of ten or twelve years. Until recent years, the methods of estimat-

ing or measuring intelligence and school accomplishment have not been sufficiently advanced to make it feasible to measure the growth of a large number of individuals by repeated measurements. We now believe that our methods are more nearly adequate for this purpose. The physical measures being employed include height, weight, bodily proportions, dentition, and ossification as shown by X-ray photographs of the carpal bones. Hitherto, most investigations of physical development have applied but one or two of these measures to the same individuals. Each measure by itself is subject to certain errors. An average of several such measures will, we believe, furnish a more reliable index of general physical development. This, as we have seen, has been the experience in the field of mental testing; single tests were inconclusive, the combining or averaging of several tests has led to results of practical value. Furthermore, our conclusions are to be drawn not from the absolute measures, but from the increments or changes in the indices from year to year. A single measure of height or weight tells little of importance, but, as first Wissler in this country and then notably Baldwin and Porter have shown, the repeated measurement of the height and weight of the same individuals over a period of years has told us a good deal about growth which we did not know before. These changes of a physical or physiological sort, when taken in connection with changes observed in the tests of intel-

ligence and school accomplishment and when supplemented by the detailed and recorded observations of teachers, will, we are confident, give us some of the desired information.

It may well be that the mental and physical development of the majority of children will prove to be regular and even, and will present no particular problems during most of the years of growth. At one period at least, namely, at adolescence, there is reason to believe that this will not be the case even for the majority.

18. *Individual Differences in the Rate of Development*

It is our present opinion, based on repeated observations on a relatively small number of individuals, that we shall find the following conditions: Children who are somewhat backward in mental development, whose yearly increments in mental age have been small and who on repeated examination prove to be correspondingly backward in general physiological development, may frequently make up for their slow start before they reach maturity. The prognosis in their cases would be better than in the case of children of the same early mental level who, at the same time, are found to be physiologically well along in the course of development. The fact that they have come on so well in general physiological development in the early years without corresponding mental growth would make their prospects less hopeful.

Similarly, some of our much heralded prodigies, who have rather petered out in later years, may prove to have maintained their relative superiority for a few years because of early maturing, supplemented by a kind of hot-housing.

The basis of the above-expressed opinion may be illustrated by reviewing briefly the observations and test findings of two or three children whom the writer has examined.

Among the cases observed in which slow or average development in the early years has been followed by rapid physical and mental development later on in the period of growth, is that of a girl who at the age of 9 years and 11 months had a mental age, as determined by the intelligence tests, of 9 years and 10 months, and an intelligence quotient of 99. Three years later, she attained in the tests a mental age of 17 years and 8 months and an intelligence quotient of 136 — a gain of 37 points. At the time of the first examination, she was at about the 68th percentile in physical height of girls of her own age; at the end of the three years she was at the 87th percentile. The acceleration in mental development was thus accompanied by a somewhat corresponding acceleration in physical growth.

A girl who entered school at the age of 6 had, as a result of systematic instruction which her parents had begun when she was 3 years old, covered the regular work of the first four or five grades of school. She

secured on examination with the general intelligence tests a mental age of between 11 and 12 years, and an intelligence quotient well over 160. In a series of performance tests for which this previous coaching had not prepared her, she did but little better than children of her own age. Although physically weak, of slender build and frequently ill, there was some evidence of certain physiological development in advance of her age which may have been in part the result of the intensive training and hot-housing to which she had been subjected. Her present superiority in the mental and scholastic tests would appear to be due in part to these factors. If this is the case, the following are some of the possibilities in her subsequent development: (1) she may continue her unbalanced development with a resulting freakish intellect or genius within very narrow limits; (2) the physiological changes of adolescence may be completely unsettling, with a nervous breakdown and the development of psychopathic traits; (3) the demands of general somatic development may become such that the initial acceleration in development proves purely temporary and the child settles back to the general level of mediocrity.

A different result is indicated in the case of a boy first examined in 1918 at the age of 5 years and 9 months. In successive annual examinations his intelligence quotient has closely approximated 100. His parents are both of exceptional abilities, and, because

of the child's general health and some suspicions of defective heart action, they have let nature take its course in the child's development. His present mental status is, it is believed, due chiefly to his native intelligence. Physical and physiological measurements and indices, including dentition and ossification, indicate slow development — a condition which may by the time of the pubertal acceleration lead to his passing well above the general average of his age. The prognosis is one which repeated measurements can alone, at present, test.

These examples illustrate the possibilities which current investigations hold for a better understanding of the influence of maturity on individual development. The complexity of the problem may be illustrated by a consideration of the way maturity may help to account for sex differences and racial differences during the period of growth.

19. *Sex Differences in the Rate of Development*

The various measures of physical and physiological development agree that girls mature earlier than boys. When judged by the absolute standards of height and weight, boys are in the earlier years taller and heavier than girls; girls then take the lead for a few years and are then overtaken by the boys. But, if judged by relative standards, namely, the percentage of their final development, girls are practically at all ages further along in growth than boys and they reach

the period of the cessation of growth earlier than do boys. These differences in the rate of development are illustrated by means of X-ray photographs of the stages of ossification. Girls at the age of six are as far along in this phase of anatomical development as are boys of seven and one half years, and are, from school entrance until maturity, about eighteen months ahead of boys in the ratio of their yearly status to their final status, or as now commonly expressed, in their anatomical indices (102). This being the case, and *assuming, for the present, the equality of girls and boys in native endowment and training up to the time of their entrance in school*, girls ought to be superior to boys in both their school accomplishments and in intelligence as now tested.

A careful examination of the literature of the tests of school accomplishment as regards sex differences does show the girls to be slightly superior to boys (83), and in the results thus far reported for the individual intelligence tests, the girls are also superior to the boys by about a point or two in intelligence quotients. In one recent study with a group test of intelligence, a difference of as much as one year of mental age at the thirteen-year age level has been reported, but, with this exception, neither in school accomplishment nor in intelligence are the girls as superior as their greater maturity would lead one to expect. A possible explanation is that since girls enter school at the same age as boys and are promoted

at only a slightly faster rate than boys, they are not able to profit by their relatively greater maturity. And since, the intelligence, as at present tested, depends so largely on schooling, they again are prevented from making a better showing in the intelligence tests. Of course we made the assumption to start with that girls and boys are equal in endowment and the effects of training at school entrance, and it is possible to argue (although the writer will not hazard it) that girls are natively not quite as intelligent as boys but that this lack is compensated for during the period of growth by their greater maturity; so they come out in the end about the same as boys in schooling and in intelligence.

20. *Racial Differences in Development*

A hardly less argumentative case into which differences in maturity are also thought to enter is that of racial differences. In one of the communities which we have recently studied, there are about equal numbers of Italian children, Jewish children, and children of an older "American" stock. The Jewish children rank highest in mental age and in intelligence quotients, then come the American children, and last the Italian. In anatomical development, as indicated by the stage of ossification of the carpal bones and expressed in terms of anatomical ratios, the Jewish children are far ahead of the other two racial groups. The Italian boys appear slightly more developed than

the American boys, whereas the American girls are a little more developed than the Italian girls. The small differences between these latter groups may be affected by a wider sampling of cases, but the position of the Jewish group can hardly be changed.

Taking for purposes of illustration this outstanding difference of the Jewish group, we should be inclined to argue that the superiority in intelligence was in part due to the greater anatomical and probably correspondingly greater physiological development; that they are, in other words, simply further along in the stage of growth; that the slower-growing American group will either develop for a longer period or that their growth will be more accelerated during its latter stages, e.g., at the adolescent period. So that at the completion of the period of growth the initial disparity between the intelligence of the two groups would disappear. This result would depend upon the duration of the period of growth and the amount of later acceleration. If both factors were operative, the American group may in the end excel in intelligence. A member of another race might well be inclined to argue otherwise! A solution of such a problem must await the comparisons of the yearly increments in anatomical, physiological, mental, and scholastic development.

The foregoing illustration suggests a comment on the much discussed differences in the intelligence of negro and white children. It would appear from the

use of such intelligence tests as the Stanford-Binet that negro children are relatively brighter in the early years than in the later years, that at school entrance, at about the age of six, they are the equals in intelligence of white children of the same social status, but that with each successive year they are progressively less bright as compared with the white children (5). Gordon, as we have seen in his study of physically defective, canal-boat, and gipsy children of little or no schooling, has made exactly the same finding.

It is pretty clear from this latter study, where, with the exception of the gipsies, racial differences probably do not enter, that the lack of difference in the extent and character of schooling, differences in intellectual and social standards, ambitions, and ideals are factors which must be carefully equated in the comparisons of groups. If these considerations also apply, as they may, in the case of the current comparison of white and negro children, they must also be carefully weighed as a possible alternative explanation of the differences just cited between the Jewish, Italian, and American children which we have taken, for purposes of illustration, as an example of the effect of differences in the rate of maturing.

When we fully realize the power of the home, of the school, and of the more general cultural environment, and take account of the complications which variations in the rate of maturing may introduce, we can hardly interpret the findings of the tests in regard to

different racial groups as evidence of hereditary intelligence alone.

From these various illustrations, it should be apparent that a further analysis of the relative influence of native endowment, physiological maturity, health, schooling, special training, and environment in general — which can only be made by means of repeated tests and observations of the same individuals over a period of years, is a present need, the meeting of which offers the promise of a better understanding than we now have of some of the persistent problems in the development of the intellect in childhood and youth.

CHAPTER V

INTELLIGENCE AND ACHIEVEMENT IN SCHOOL

1. *The Intellectual Limitations of the Individual, of the Family, and of the Race*

The wave of intelligence testing which has swept over American schools has carried with it some débris: among other things the much-discussed notion of a fixed intellectual endowment, with which a child is born, which neither he, his parents, nor his teachers can by taking thought alter, and which the intelligence tests are designed to measure. The considerations presented in the preceding chapters have, I trust, made clear that, on the contrary, what the intelligence tests measure is definitely affected for better or worse, that it is increased or decreased, by what the home and the school, or the parent and the teacher, do for their children and pupils.

The cultural anthropologists and psychologists, as contrasted with those who believe in the preponderating influence of that which is instinctive or inherited in shaping the destinies of man, are insisting with renewed vigor, regarding this recent formulation of the old problem of nature versus nurture, that the intelligence tester is overemphasizing nature. Professor Boaz has recently pointed out that, although there are evidently marked anatomical differences between men,

different individuals may become adjusted to the same demands. "The healthy individual without harm to his body, may at one time be a vegetarian and at another time may live on an exclusive meat diet. He may live a lazy life at the level of the sea, or subject himself to strenuous exercise in high altitudes. There are limits to adaptability that depend on the soundness of the organism, but within wide limits of external conditions, an optimum of efficiency may be maintained" (21). There is a "margin of safety which exists for all organisms." So, given the environmental demand, or, as the psychologists like to say, "stimulus," the same individual, the same family strain, and the same race may show a wide range of intellectual functioning. With such considerations in mind, we may well be cautious in prophesying the limits of individual, family, or race achievement. Yet this is in fact what the intelligence tester has been attempting to do.

2. *School Progress as Determined by the Intelligence Quotient*

Intelligence tests are now being used to a certain extent in school and college to set standards for individual and group accomplishment. We are told that a child with an intelligence quotient of 70 cannot expect to complete the work of more than the fourth or fifth school grade, however long he may stay in school; that in order to finish the eight grades with comfort, he

must have an intelligence quotient of 100; that to enter high school he should be above the average of his age in intelligence, and to graduate from high school, without undue exertions, he must have at least an I.Q. of 110. If the student thinks of entering college, he should first ascertain that he has an I.Q. of 115 or better, or he may be in danger of falling by the wayside, and if he has any desire for a *cum laude* to say nothing of the *magna* and *summa* or of Phi Beta Kappa he is, if without an I.Q. of 120, doomed either to disappointment or to hard labor. Had the famous Indian student whose visiting card bore the inscription "Failed A.B." also announced in another corner of his card a low I.Q., his failure to receive the bachelor's degree would seem to the intelligence tester completely accounted for.

3. *The Freedom of the Intellect*

Of course, these statements are of what is said to hold on the average, and exceptions are noted, but with the expression of such finality for the average even, it is small wonder that this attempt at the standardization of the intellect has been regarded as but another consequence of a mechanistic and materialistic age. As men have fought to preserve their notions of the freedom of the will, so now the battle rages for the freedom of the intellect. The really important limitations to the freedom of the will have been found to be those which are self-imposed or im-

posed by society. But, in the case of the intellect, in addition to the limitations for which the individual may alone have himself to blame, and to those set by the family, the school, the occupation, and by the more general cultural environment, there are limitations which appear intrinsic or native. Psychologists have at times in their discussions assumed that the individual's limitations were due solely to intellectual endowment which he inherits, and that the intelligence test measures solely this hereditary endowment, or native intelligence. It is to this unwarranted assumption that the apparent finality of the preceding statements is due. But no one has succeeded in separating these factors, and the intelligence test measures the composite result. Some of these factors may be under control in a given case and others may not. Even such a conservative statement as the following from a recent book (72) errs in regarding endowment as the one factor isolated by the tests.

> Either everybody is born with the same intellectual potentialities or not. Either everybody is equally endowed or differently endowed. . . . Those of us who believe in psychological tests feel that, however crude and inadequate our present methods may be, we have at least at our command a means of discovering the grosser differences in intellectual endowment in early childhood.[1]

But the shoe fits quite as well on the other foot and we may then say that what the intelligence test does

[1] E. A. Irwin and L. A. Marks: *Fitting the School to the Child.* By permission of The Macmillan Company, publishers.

is to anticipate or foresee what the school and society are going to do to the individual in the course of time. So long as the school and society remain as they are, this previsioning is possible in a great many cases — and it is very useful. As we have seen, the teacher's judgments, marks, and examination grades also share in this distinction and service. The tests and the teachers predict what the individual is likely to learn from what he has already learned. But in how far the previous learning, which is the basis of prediction, is due to faulty and limiting habit and in how far to limited endowment is a matter of conjecture. Here no more than elsewhere can we separate nature from nurture; intellect from culture; neither the body nor the mind develops *in vacuo*.

If we do not like the prophecy of the tests, we may try to change such conditions as are under our control; or we may change the tests. The latter alternative is not altogether bizarre. Since schooling is not all of education, non-scholastic tests may discover other aptitudes, and, eventually, the schooling may be changed to allow of their development. Indeed, this appears to be one of the great opportunities of the intelligence tests. Other means, such as teachers' marks — and especially the average scores of a lot of subject-matter tests — will predict quite as well as the present intelligence test how the individual is coming out in school. If the intelligence test can discover other abilities than those required to master the school

curriculum, a different prognosis may be made for the individual, when opportunities are given for the development of these latter abilities.

4. *The Intelligence of the School Dullard*

Neither the school nor the tests at present gauge all the intellectual powers of a man. We need but recall some of the names of illustrious men and women who were either school failures or in whom the contrast between the accomplishments in life and their attainments in school is extraordinary. Linnæus, Pasteur, Ruskin, Charles Darwin, Sir Isaac Newton, Alexander von Humboldt, Heine, George Eliot, Hegel, Hume, Spencer, Liebig are among those who might be cited (116). In some such instances, the art of the biographer tempts him to too great contrasts and exaggeration, but in the examples cited the evidence is sufficiently objective.

Linnæus was regarded by the director of the German Gymnasium in which he studied as unfit for a profession and was advised to take up a trade. He was sent to the university with this dubious recommendation: "Youth at school may be compared to shrubs in a garden, which will sometimes, though rarely, elude all the care of the gardener, but if transplanted into a different soil may become fruitful trees. With this view, therefore, and no other, the bearer is sent to the university, where it is possible that he may meet with a climate propitious to his progress."

Charles Darwin says in his autobiography: "During my whole life, I have been singularly incapable of mastering any language. . . . When I left the school, I was for my age neither high nor low, and I believe that I was considered by all my masters and by my father as a very ordinary boy, rather below the common standard in intellect."

Herbert Spencer believed his memory, "in respect both of quickness and permanence," was below par. He developed an antagonism to rote memorizing which may explain his difficulty in some of his school subjects. "A related fact," he adds, "is that throughout boyhood, as in after life, I could not bear prolonged reading. . . . While, however, averse to lesson-learning and the acquisition of knowledge after the ordinary routine method, I was not slow in miscellaneous acquisition."

There are other examples where an even more specialized disability, such as we shall be especially interested to examine in the next chapter, gives the appearance, until it is compensated for by other learning, of a general deficiency. Liebig believed that one reason for his very poor showing in school was due to a defect in his auditory memory, as a result of which he could retain little of what he heard. The customary emphasis upon oral instruction in the early forms or grades of school may, as we shall see, produce in such cases a general retardation in learning which seems quite out of proportion to the initial cause.

We recognize, of course, that most school failures and most pupils of low I.Q., as well as many who do but passably well in school and in the tests may have *general* intellectual shortcomings. In others, there may be special disabilities which simulate for a time a general deficiency. In still other cases, the shortcomings appear confined to the somewhat narrow range of abilities which the present tests and the school alike require. The latter individuals, and this is a point stressed in the preceding chapter, which we would now reiterate, may be possessed of other intellectual abilities quite as significant as the abilities of which the tests and the schools are more particularly cognizant.

5. *The Problem of Retardation in School*

One other argument for the preponderating influence of endowment or intrinsic factors, over the environmental or extrinsic factors, may be mentioned. The American school world was aroused at the beginning of this century by studies which showed the great numbers of retarded pupils in school. Ayres in his *Laggards in our Schools* (7) listed as the causes of retardation: sickness, physical defects, irregular attendance, poor home environment, difficulty with the English language, too rigid promotion scheme, and lack of application. He did not mention what is now said to be the chief factor — lack of intelligence. In communities where many of the conditions named by

Ayres have been greatly improved, where visual and auditory defects have been corrected, tonsils and adenoids removed, teeth filled, where there is less sickness from contagious and other diseases, where school attendance is much more regular, the teaching and facilities of instruction bettered, and the standard of life in the community greatly improved — in these communities, there is still as much retardation in school as before. Therefore, the argument runs, the real cause must be due to something else which has not been remedied, and the only thing left that we can think of is an inborn lack of intelligence, which, since the amount of intelligence is fixed at birth, we cannot alter. But this is not quite the whole story. As a result of the physical, scholastic, and social betterments, improvement in intelligence may really have been brought about, but with the improvement, educational standards have been also gradually advanced.

Although everybody has improved and the average attainment has advanced, relatively to these new and higher standards set for achievement there are just as many laggards as there were before. There would be much justification for saying that the problem of school retardation is one of standards rather than of intelligence.

6. *The Classification of Pupils by Intelligence Tests*

Whether or not all individuals are alike in endowment at conception (and the writer does not believe

they are, but belief is quite a different thing from proof), it appears certain that they are not equal at birth. It is also evident that they are not equal in attainment when they enter school at the age of five or six. Furthermore, the range of capacities or the attainments of pupils is so great in the ordinary first-grade class that it is not possible to suit instruction to all. The promise of the intelligence test is that, by recognizing these differences earlier and more unerringly than teachers or the school as an organization has been accustomed to do, it is possible to classify pupils at the start into more homogeneous groups, a thing which the school eventually does by retarding some of its pupils and eliminating others.

In the country at large, it is said that a little over a third of the pupils who enter school reach the high school, and that only between a fifth and a tenth graduate. It may now be said that the major reasons for leaving school are either inferior mental ability, or the lack of the particular kinds of abilities or attainments which the schools require. The present intelligence tests are so constituted that they, also, require for their passing chiefly these scholastic abilities. The desirability of the school and the tests recognizing the possibility of usefulness in the abilities of the eighty or ninety per cent of the population who leave school is therefore again reinforced by a consideration of the problem of elimination from school.

But taking things as they are, we may now inquire

what the school does with the abilities which both it and the tests recognize. We may speak of the relation of intelligence to school accomplishment first, in the case of individuals, secondly, in the case of school classes, and thirdly, in the case of whole schools or school systems.

7. *The Practices of the School in the Classification of Individuals of Varying Mentalities*

Some of the findings in regard to individuals were suggested in one of the introductory paragraphs. The education of the regular schools is practically confined to children with I.Q.'s over 50. Children with less intelligence can seldom be taught the required three R's. In the distributions of intelligence in typical communities shown in a preceding chapter, there were no children enrolled in the regular classes with I.Q.'s of less than 50, and none of lower caliber entered the first grades. Children with intelligence quotients lower than 70, although they may be equipped with the tools of education, that is, they may master the mechanics of reading, writing, and arithmetic, can make very little *use* of the tools of education. And since this is what they must do after the fourth grade, if not before, few children with I.Q.'s of less than 70 are found above this grade. Children with I.Q.'s of from 70 to 85 have a hard time in school but some of the better may, after a year or two of repetition or retardation in the lower grades, finally reach the eighth

grade. Graduation from the grades is even then an act of courtesy on the part of the school rather than a result of the completion of its requirements. Even children with I.Q.'s of 85 to 95 are apt to spend on the average an extra half year in completing the eight grades. Children of I.Q.'s of 95 to 100 usually finish within the expected time.

It is the group of children with I.Q.'s of from 85–95 for whom Burt (27), as judged by his studies in the London schools, believes the school does the most in proportion to their abilities. They are relatively the most advanced in the school. It is on the achievements of these children in particular that the claim, cited in the first chapter, that the school has done more for the dull than for the bright pupils, is based. But in view of the fact which we have subsequently stressed, that the literary-academic course through which the scholastic dullard is prodded or coaxed is not as suited to his abilities as other courses of training might be, we may fairly reopen the question as to whether the school after all does do more for its dull than for its bright pupils.

Even the pupil of average intelligence finds his powers taxed to their limits by the high-school requirements. Finally, children of superior I.Q. should theoretically be able to complete their schooling in as much less time as the inferior require more time to do so. Children of 125 I.Q. should, for example, be able to finish the eight grades in six years, and those of 150

in four. The results of intelligence testing have here raised many new problems the discussion of which will be reserved for a subsequent chapter.

8. *Setting the Standards for Class Achievement*

Whatever doubts may remain as to the use of the intelligence tests in setting the standards for individual accomplishment, their use in setting standards of achievement for *classes* of pupils is not open to the same reservations. An example or two must suffice to illustrate these latter uses of the tests.

Among the third grades of one city are three classes: Class A with a median I.Q. of 122, Class B with a median I.Q. of 103, and Class C with a median I.Q. of 83. There are, then, thirty-nine points of difference between the median I.Q. of Class A and Class C. Class A is, on the average, two and one half months younger chronologically than Class B, but is eighteen months older on the average in mental years. Yet Class B excels Class A in tests in the four processes of arithmetic, in solving arithmetical problems, and in the rate and quality of silent reading as tested by standard tests. Class C averages a year older in life years than Class A, the mental age averages two years and eight months less, yet this class secured the same median score in the arithmetic test, but it did much worse in the reading test. Such comparisons suggest, as Burt (27) remarks in reporting similar findings, "That intelligence varies more widely than school capacity, and

that, possibly, school methods prime and prod the backward a little nearer to the average standard, but do not exploit to its utmost the inborn intelligence of the more acute. They tend to level attainments without equalizing ability."

A similar comparison of two fifth grades in the same town by Terman and Hubbard (119) disclosed the following facts. In Class A, 44 per cent of the intelligence quotients were 110 or over, in Class B, only 10 per cent; in Class A, but 19 per cent of the I.Q.'s were below 90, in Class B, there were 44 per cent below 90. The median I.Q. of Class A was 108 and its median mental age about twelve years; which corresponds to the level of a normal sixth grade. The median I.Q. of Class B was 91, its median mental age a little over ten years, or about that normal for an average fourth grade. It is quite unreasonable to expect equal accomplishments from these two classes. But this uniformity is what is ordinarily sought by the school, and such an objective explains why the differences in the attainments of almost any classes which may be compared will be found to be less than their differences in intelligence.

We may now inquire what the school system as a whole does with the range of individual differences in intelligence which is yearly presented with each entering class of pupils.

We saw in the last chapter that in a community of average culture and opportunity, the children who

enter school at the legal age of six are, as would be expected from the premises, of average intelligence, and their variations or differences in intelligence are distributed according to the frequencies found in most biological phenomena. The chart on the upper half of Figure 25 on page 85 is a good illustration of such a group. The median or average intelligence quotient is practically 100 (99.8). In the central and highest column of I.Q.'s from 96 to 100 inclusive, there are about 125 children, or a little less than one fifth of the total group. In each of the columns on either side of this central column, namely of I.Q.'s from 91 to 95, and 101–105 inclusive, there about one sixth of the children. In each of the columns on either side of the last mentioned, namely those I.Q.'s of 86–90 and 106–110 inclusive, there are about one tenth of the children.

Now the standards of the ordinary first grade are so set that children who in these tests have mental ages of less than six, which is about one sixth of this present grade, have difficulty; and a certain proportion varying from a sixth to a fourth fails of promotion. The result is that the first grade has some children left over from the year before. The distribution of the first grade is therefore weighted somewhat in the lower ranges, and the average of the intelligence is a little below the norm of the children entering each year. (Compare Figure 24, page 83.) In the first grades of the same community from which the last chart was drawn, the median I.Q. is 97.7. The somewhat larger numbers

below the central column shown above can be seen by inspection of the graph shown in Figure 24. This process is repeated in the second, third, fourth, and fifth grades, with the result that these distributions are all weighted in the lower range of scores, as may be seen in Figures 34A and B. The median I.Q. of each of these grades is 97 to 98.

These charts are based on the combined results in three fairly typical or average New England towns. By the time the sixth grade is reached, some of these children are old enough to leave school, and those who are not promoted at the end of the sixth grade are apt to do so. The result of these factors is that for the first time in the school grades we find in the sixth grade an approximation to the normal distribution, and a median, or average, I.Q. of 100, or slightly better. In these sixth grades it is 101. The abrupt cutting off of the curve below the score of 45, or of those who have a mental age of less than ten, is due chiefly to these two factors of less retardation and more elimination in this grade. Indeed, these factors are also operative in the lower ranges of Grade V. The promotions into the fifth and sixth grades are also more carefully scrutinized than in the previous grades. A child, as we shall see later, who has not learned to read may be able to pick up enough from what he hears in class to be passed on with some hesitation as far as the fourth grade, but he cannot possibly get further except by unusual leniency.

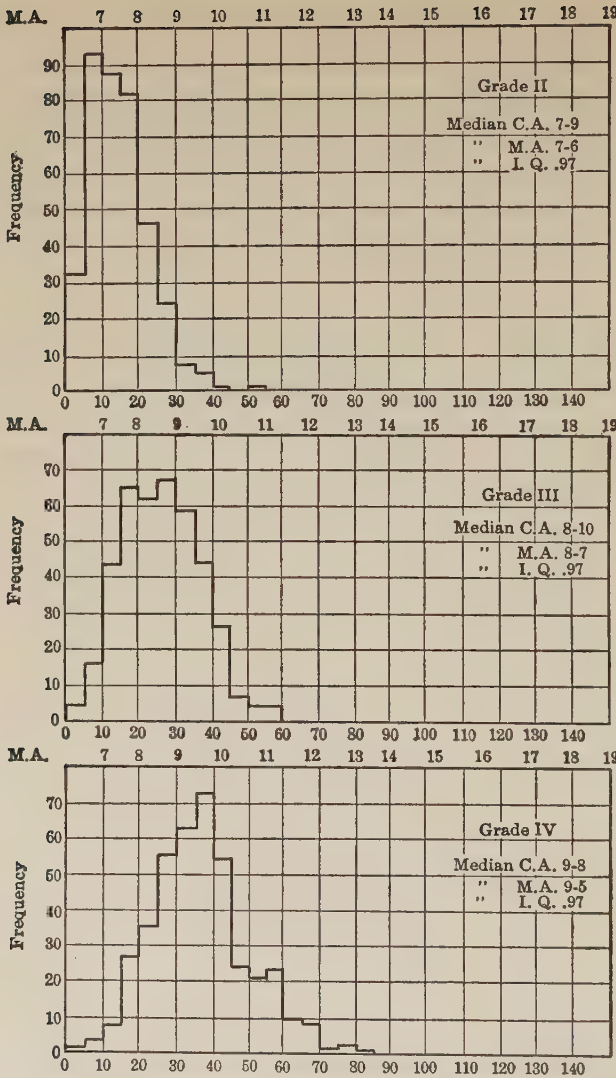


FIG. 34A. FREQUENCY DISTRIBUTIONS OF INTELLIGENCE TEST SCORES IN GRADES II, III, IV

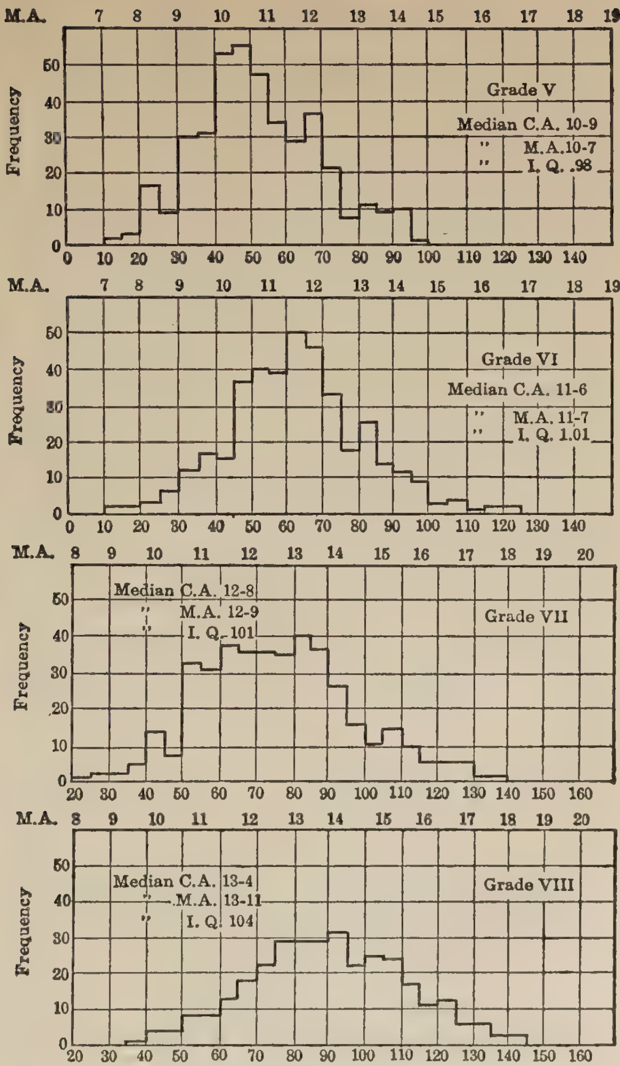


FIG. 34B. FREQUENCY DISTRIBUTIONS OF INTELLIGENCE TEST SCORES IN GRADES V, VI, VII, VIII

One may wonder what children with mental ages of less than ten are doing in this grade at all. They are, of course, children of life ages of thirteen, fourteen, and fifteen, who, as a result of having spent two to four years longer in the grades than the average, are able to hold their own more or less successfully in a grade for which their mental age would seem to disqualify them.

In the seventh grade (see Figure 34B), although the median intelligence quotient remains at 101, the distribution is overweighted in the lower ranges of scores by those who have been held back from advancement to the eighth grade. The danger would seem to be that if these pupils were admitted to this latter grade, there might be the temptation of graduating them. The grouping of these pupils in the lower ranges of the mental ages of the seventh grade is readily noted by comparison with the eighth-grade distribution. The median I.Q. of the eighth grade advances abruptly to 104, because of the factors just noted in regard to the seventh grade.

The high-school distributions are characterized by gaps in the lower scores or ranges of mental ages. This is particularly noticeable in the ninth and tenth grades. (See Figure 34C.) This, of course, is due to the fact that the pupils of lower intelligence have not gone on to high school, and some of those who have entered are gradually weeded out. The latter process is evident in the difference between the distribution of the freshmen, or ninth-graders, and the seniors, or twelfth-graders.

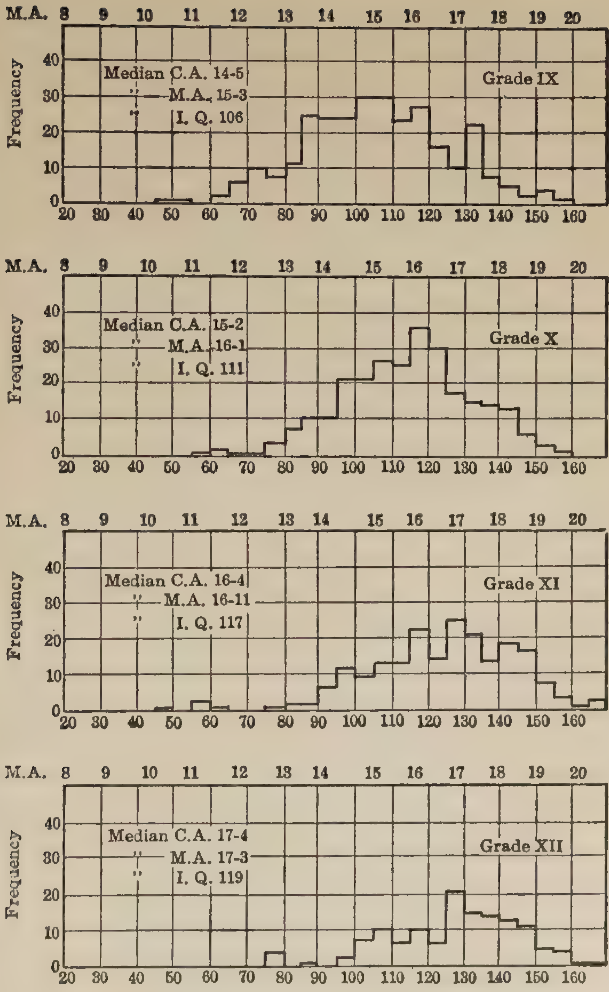


Fig. 34C. Frequency Distributions of Intelligence Test Scores in Grades IX, X, XI, XII

(It would be interesting to observe the effect of the Junior High School organization on these distributions which represent the older methods of classification.) The median or average of intelligence quotients is gradually increased by this process from an I.Q. of 104 for the eighth grade, to 106 for the freshman year, 111 for the sophomore, 117 for the junior, and 119 for the senior year. These latter I.Q.'s (of the high school) are calculated on the basis of an average adult mental age of fourteen and a half. A justification for this basis of calculation will be offered in a subsequent chapter.

Thus does the ordinary school system handle the problem of individual differences in the intelligence of pupils. Some of the facts may be better seen by an inspection of the figures of Table 10. The large overlapping of the scores received by pupils in the various grades on the intelligence test was apparent from the series of graphs shown in Figure 34. This overlapping is due in part to the gradually increasing range of intellectual differences in each advancing grade. The children in the middle half of the second grade, that is, in the half grouped about the median of the grade, differed from each other to the extent of eleven months of mental age, whereas, by the eighth grade, the differences between this group were equal to twenty-nine months of mental age. This increasing variability in the intelligence of ascending grades may be noted in the third line of the table designated at the left by $Q_1 - Q_3$ M.A. — which shows the range of mental

TABLE 10. THE MEDIAN CHRONOLOGICAL AND MENTAL AGE OF PUPILS IN THE SEVERAL GRADES OF THE ELEMENTARY AND OF THE HIGH SCHOOL

	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Median C.A.	7–9	8–10	9–8	10–9	11–6	12–8	13–4	14–5	15–2	16–4	17–4
Median M.A.	7–6	8–7	9–5	10–7	11–7	12–9	13–11	15–3	16–1	16–11	17–3
$Q_1 - Q_3$ M.A.	11 mos.	16 mos.	16 mos.	23 mos.	23 mos.	28 mos.	29 mos.	27 mos.	24 mos.	27 mos.	24 mos.
Gain in M.A.		13 mos.	10 mos.	14 mos.	12 mos.	14 mos.	14 mos.	16 mos.	10 mos.	10 mos.	4 mos.
Median I.Q.	97	97	97	98	101	101	104				
(Av. Adult = 14½)								106	111	117	119
(Av. Adult = 16).								106	106	106	108

ages between the 25th percentile, or Q_1, and the 75th percentile, or Q_3, of each grade. The average gain in mental age of the successively higher grades over the preceding grade is shown in the line designated "Gain in M.A." Disregarding the exceptionally small gain in mental age of the twelfth grade over the eleventh there is, on the average, a difference of approximately twelve months of mental age between the medians of the successive school grades.

Despite this advance *on the average* from grade to grade, the variability in intelligence within all of the grades remains, as it would seem, excessive. Some of the best of the pupils from the second and third grades equal in their scores the poorest of those in the eighth and ninth grades. Allowing for the probability that some of the poorest scores are due to accidental failures and that they do not therefore represent the true intellectual levels of those who made them, still it may safely be said that there are in each grade pupils the equals in intelligence of pupils classified five or six grades above them.

This finding reveals an important educational problem. For successful instruction in classes, there must be a certain degree of homogeneity of intellectual capacity as well as of attainment on the part of the pupils who are classed together. If the intellectual differences are too great, class instruction is not possible. If instruction is suited to some, it will not be suited to others; if some are taught, others will not be

taught. The determination of the maximum of intellectual dilution at which class work is possible we must leave at present to the judgment of the skilled teacher. We may observe, however, that the standard varies among schools and that, in general, the greater the intellectual concentration at the different grade levels, the better the school. An extended comparison of schools from this angle might well lead to some profitable conclusions. We shall present a few examples of the classification in different school systems. With the aid of the accompanying graphic representation, a bird's-eye view may be secured of the way different schools meet this problem.

9. *The Classification of Pupils in Different School Systems*

Figure 35 shows in its upper half the chronological age-grade, and in its lower half the mental age-grade classification in the first eight grades of a city in the neighborhood of Boston. Because of the great overlapping in successive grades, the distributions are shown only for the first, second, fourth, sixth, and eighth grades. The differentiation between grades is seen here, as in many communities, to be more a matter of chronological age than of mental age. In the mental-age distributions, the variability increases with each advancing grade. After the third grade the overlapping is so great that, except for the gradual advance of the average, or median, mental age, differen-

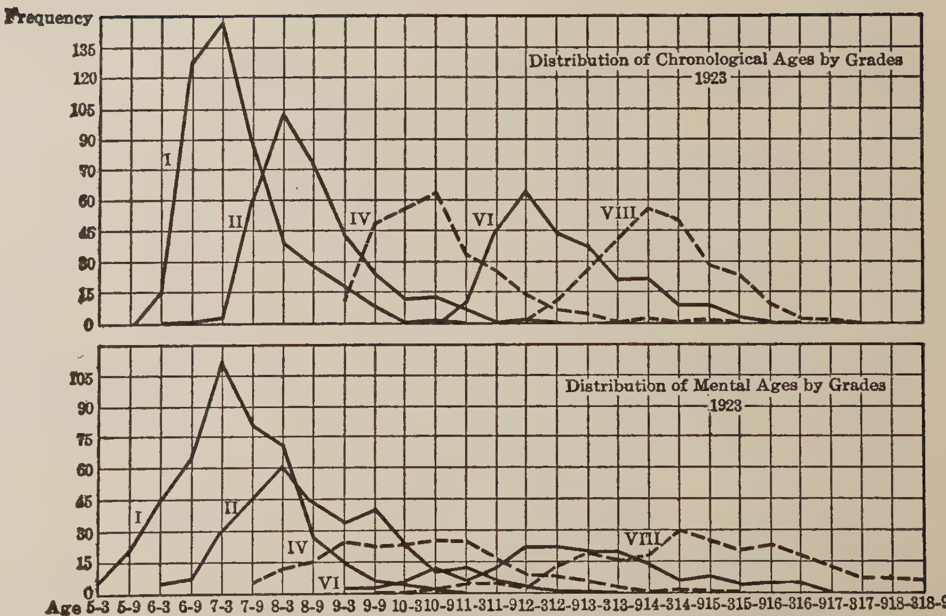


FIG. 35. DISTRIBUTION OF CHRONOLOGICAL AND MENTAL AGES BY GRADES

tiation is difficult. From this comparison, we are tempted to conclude that advancement in school is determined more by the ages of pupils than by their intelligence.

This study was made in the spring of the year 1923. At that time of year, the most frequent chronological age, as the most common mental age in the first grade, was *seven* years and three months, as may be seen by the *peaks* of each distribution. The number of individuals who vary from this common physical and mental age in the first grade are roughly, but only roughly, the same; in other words, the distributions bear some resemblance. In the second grade also the peaks of the life and mental age distributions are at the same age, namely *eight years and three months*, but whereas there are about 105 pupils of approximately this chronological age, there are but 60 of this mental age. Further, there are about 235 individuals in the second grade between the ages of 7 years 9 months and 9 years 2 months inclusive, whereas in this same range of mental ages there are but 150 pupils. These detailed comparisons are made to impress the fact that by the time the second grade is reached the differences in the mental ages of the pupils are already greater than their differences in chronological age. The fourth, sixth, and eighth grades are pretty well differentiated by the chronological age of their pupils, whereas there are so many pupils of the same mental ages in these grades that it is hard to tell the one from

that of the other. These details reinforce the statement that in this particular city advancement in school is determined more by the ages of pupils than by their intelligence.

Classification on the basis of mental age is somewhat better in a second and socially more favored community, which is adjacent to the community we have just examined by this somewhat novel method. The distribution of mental ages in the first, third, fifth, and sixth grades of this second community is shown in Figure 36. In the fifth and sixth grades there is, how-

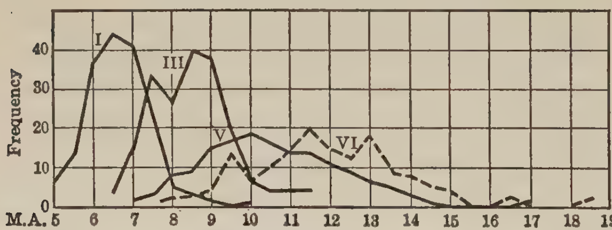


FIG. 36. DISTRIBUTION OF MENTAL AGES BY GRADES

ever, a difference of about ten years of mental age in each case between the pupils of lowest intelligence and the pupils of highest intelligence.

Figure 37 shows the distributions of chronological ages and Figure 38 shows the distributions of intelligence test scores by grades in the schools of three Massachusetts towns. Each of these communities has been regarded, as the result of special studies, as a fairly average or typical New England town.

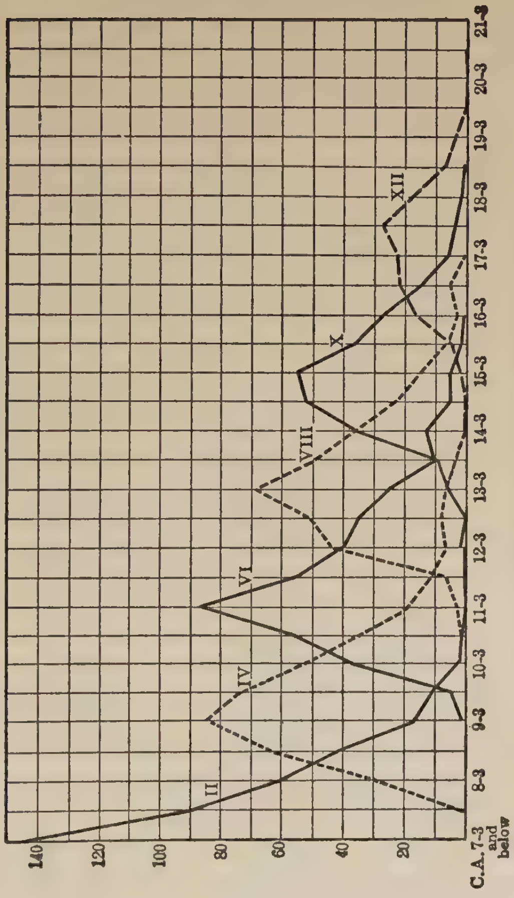


FIG. 37. DISTRIBUTION OF CHRONOLOGICAL AGES

Distribution of chronological ages is shown for the second, fourth, sixth, eighth, tenth, and twelfth grades in these communities. Again, as before observed, the differences in the life ages of pupils in these

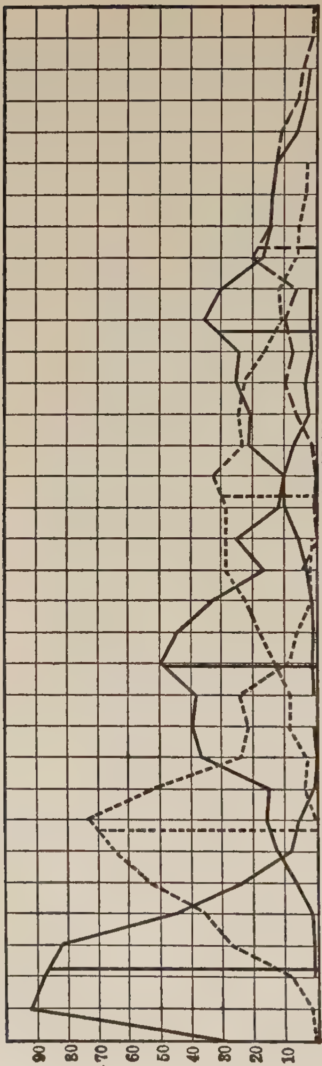


Fig. 38. Distribution of Intelligence Test Scores by Grades (Dearborn, Revised Series II)

various grades have more to do with their grade classification than the differences in their mental ages. With such a chart before him, or preferably, because of the confusion introduced by the overlapping of these charts, a series of such charts of the mental ages of the separate school classes from the first grade through the high school, a superintendent of schools may see almost at a glance what children of varying intelligence accomplish in his schools, or, putting it the other way about, what the school does with its varied intellects.

The proposals and trials, now being made in some cities, of clas-

sifying pupils on a mental-age basis are the result of such conditions as have just been shown. We shall examine these attempts at a better intellectual classification of pupils in a subsequent chapter. In order that we may keep in mind just what the conditions now are, we note that the middle half, that is the fifty per cent of the pupils found on either side of the median, differ in the first and second grades by a little less than one year of mental age; that this difference is gradually increased in subsequent grades until, in the fifth and sixth grades, it equals two years of mental age. The differences are even greater in the seventh and eighth grades, but, in the high school, again average about two years of mental age. These statements are based on the findings in the combined grades of the three communities last mentioned. When this comparison is made in terms of intelligence quotients, we find that a class at least half of whose members differ in either direction from the average by not more than approximately ten points in intelligence quotients is, according to current practice, considered sufficiently homogeneous for purposes of instruction. Some such statement would evidently be useful to a superintendent of schools in considering the problems of grade classification, and it may be kept in mind as roughly describing current practice. We shall employ this statement in a subsequent chapter as a standard by which to estimate the success of the attempts now being made in many cities to make grade classifica-

tion more a matter of mental than of chronological age.

10. *Hiding Lights under Bushels*

In the elementary schools of neighboring Massachusetts towns, we have found the median intelligence quotients to vary from 85 to 115. Figure 39 shows the distributions of intelligence quotients in the first three

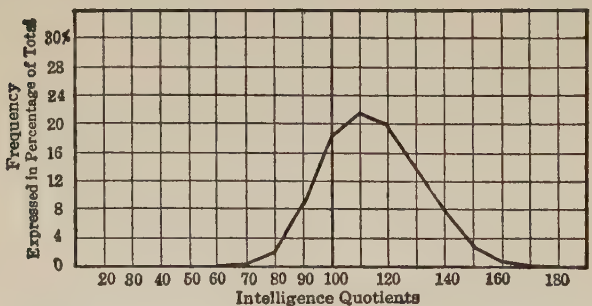


FIG. 39. DISTRIBUTION OF I.Q.'S, GRADES I, II, AND III

I.Q.	f	PER CENT OF TOTAL f
55– 64	2	0.2
65– 74	2	0.5
75– 84	25	2.1
85– 94	103	8.8
95–104	218	18.6
105–114	252	21.5
115–124	239	20.6
125–134	165	14.1
135–144	96	8.2
145–154	43	3.7
155–164	15	1.3
165–174	4	0.3
175–184	2	0.2

$N = 1170$
$M = 114.1$
$Q_3 = 127.1$
$Q_1 = 102.5$
$IQ = 12.3$

grades of an unusually favored suburban community. The median I.Q. is 114. The intelligence quotients range from 60 to 180. It will be recalled that, in the more average communities previously examined, the usual range is from 50 to 150. This group of early grade children are, in comparison with the children of more average communities, as select as is the average high-school class as compared with the average run of pupils who enter the first grade. This will be more apparent from the following discussion. Much more should evidently be expected of a school system which has such a fine lot of material on which to work, than of school systems which must spend their efforts on children who are as far below the average as these are above. But these expectations are not always realized. We have seen that, within the same school system, advantage is often not taken of these differences in the intelligence of pupils. And, as between different communities or school systems, the differences in educational attainments are not comparable to the differences in their educational opportunities.

There are some schools which are even more fortunate in the selection of their pupils than those we have thus far examined. In the case of one such school we have discovered evidence which would lead us to believe that it has indeed lived up to its opportunities. As the school is frankly a college preparatory school, it is therefore fair to judge of its accomplishments by the records which its pupils make in college. In

passing, it should be said that for other types of schools, this may not be a fair measure of attainment.

11. *Schools of High Intellectual Level and of High Accomplishment*

In order to give a standard for comparison, the last graph in the series shown in Figure 40 presents the distribution of intelligence quotients in three communities which, when taken together, are believed to represent fairly average or typical conditions, at least for this part of the country. All children, from the second grade through the high school, are included — 3623 cases in all. The median I.Q. is 103. The range of the middle fifty per cent of cases is from 91 I.Q. to 114 I.Q. The total range of cases is from 50 I.Q. to somewhat over 160 I.Q. The second graph shows the selection which takes place within one of these school systems, being the distribution of the intelligence quotients of 275 pupils in one of the high schools. The median I.Q. is 114, which is at the 75th percentile of the distribution below it. The 25th percentile of the high-school group is 103 which is at the median of the total distribution of the cases in these three towns. The selection of the high-school pupils is such, therefore, that they may be said, without inquiring too carefully in regard to possible zero points, to be about twenty-five per cent more intelligent than the total group. Their superiority to an unselected group of pupils is really somewhat greater than is shown by this

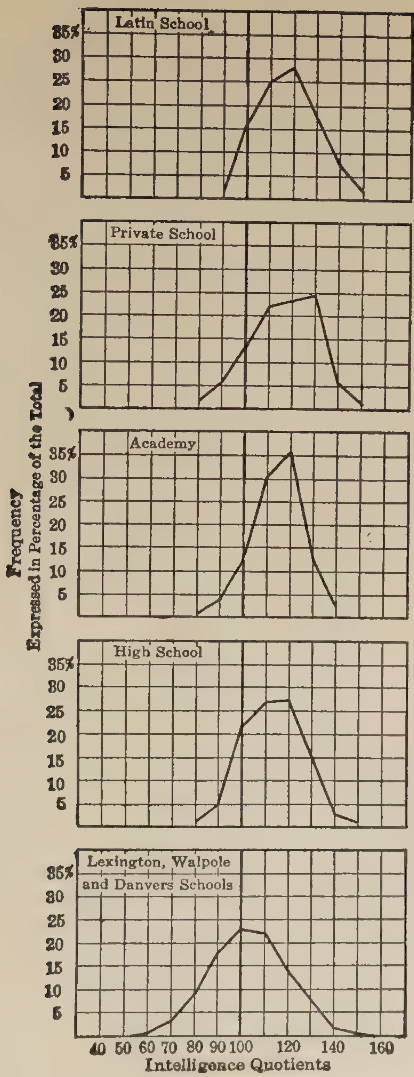


FIG. 40. DISTRIBUTION OF INTELLIGENCE QUOTIENTS OF PUPILS IN DIFFERENT SCHOOLS

comparison. If we should take as a group for comparison all of the nine-, ten-, and eleven-year-old children in these towns, and at these ages, practically all of the children are in school — that is, few have been eliminated — the median I.Q. is *100* instead of 103. The total group, as shown at the bottom of Figure 40, is therefore itself somewhat selected, since it includes upper-grade and high-school children.

The graphs above that of the high school show the distribution of intelligence quotients in two private academies, one a school for girls, and the other a school for boys, and the top graph, the distribution of intelligence quotients in a semi-public Latin school. Although these schools include pupils of the last six grades instead of the last four, as in the high school, they are still higher in average intelligence. The median I.Q. in the girls' academy is 116, in the boys' 118, and in the Latin school 124. In the latter school, where there is, of course, an unusual selection, the median child is above the seventy-fifth percentile of the average high school, and less than a sixth of the school are below the median of the high-school group. With a few exceptions, they are all above the average of the unselected group of the average communities, and ninety per cent are the equals or superior to the best twenty-five per cent of the unselected group.

With the recent strides which have been taken in the development of tests of school accomplishment, it might be possible to determine by the use of such tests

whether the attainments of these pupils are such as might be expected from their superiority in intelligence. In the absence of such specific tests, an answer to this question may be found in the college records of these pupils. An investigation of the college records of pupils from this Latin school, made shortly prior to the application of intelligence tests in the school, showed that ninety per cent of the graduates entered college, and that forty-three per cent of them were continuing their studies five years after graduation from school. At the time this study was made, only fifty per cent of public-school graduates were going to higher institutions of learning, and less than thirty-three per cent to college. The records of these pupils in college were at least equal to the average. When it is remembered that the estimates of the intelligence quotients of college students, if made on the same basis as those calculated for these pupils, vary from 120 to nearly 140, it is clear that the pupils from this Latin school were at least holding their own among their peers.

In conclusion, we may say of the relations of intelligence to achievement, that, whatever our hesitation in believing that the results of intelligence tests may justify a narrowing or widening of the prospects of a given individual (since it takes longer to change the masses than it may take to change the individual) the intelligence examinations can for some time to come, profitably be used in school to set standards for class and group achievement.

CHAPTER VI

SPECIAL ABILITIES AND DISABILITIES

1. *The Relation of Special Talent to General Ability*

"The British press," according to Ballard (10), "refers to mental tests as though they were new things and invented by Americans," and he promptly points out what is, of course, true that they are "neither new nor American." But the press, if somewhat careless about historical values, has an unerring instinct for the practical values, and it recognized that there was at least something novel about the way the tests were being used. It also sensed that, whatever rights Americans might have in the tests, possession is nine points of the law, and that the tests had taken possession of Americans as of no other people. The practical American business man who advertised, "Boy of high intelligence wanted — I.Q. not less than 115," not only showed that he was up to the times, but also that he knew what he wanted. He wanted a bright boy of all-round ability, not a specialist, but one who could take hold of any odd job and give a good account of himself. This is just the sort of boy the intelligence tests intend to identify. They are not supposed to take stock of special talents, but to see to it that there is a high average in a lot of different abilities. In fact, one theory which underlies the test procedure is, as

we have seen, that there is a common fund of ability in all special skills, and that if a person is gifted in one thing, as a rule he will be better off than the average in other desirable intellectual traits. But there are exceptions to the rule and it is with the exceptions we are concerned in this chapter.

Sir John Adams (1), in describing the case of a particularly high I.Q., writes that, although "the New York boy with an I.Q. of 187, and the Dundee boy with an I.Q. of 200 do not appear to have a violent bias towards any particular type of work," the "little boy whom he investigated at Twickenham" owed his remarkable I.Q. of 180.5 to his special skill in dealing with numbers. Skill in the use of numbers and in language are *the* two accomplishments which help most in the intelligence tests — as they also help most in school. When we examine the report of the New York case more closely from this angle, it appears that linguistic abilities — and to a much less extent numerical abilities — are in good part responsible for his remarkable records in the tests and in school; and there is at least one striking lack which militates against the description of the boy as possessing a well-rounded intelligence.

2. *A Case in Point: The Effect on the Tests of Special Linguistic Ability*

Some of the facts of the case as reported by Dr. Hollingworth (66) and her collaborators are: The boy

when tested in 1916 was eight years and four months old and in the eighth grade. His mental age was 15 years and seven months, and his I.Q. 187. He had "an extraordinary appreciation of the exact use of words and of the shades of difference between words"; "a prodigious ability for comprehending and formulating abstract ideas and for working with symbols." He solved the three mental arithmetic problems of the fourteen-year level in less than a minute each without error.

In addition to his regular school work, the child has covered the following special work in language and mathematics, either with a tutor or with his mother: Geometry; algebra, as far as equations; Latin, partial knowledge of the four declensions (he has been taught by the direct, informal method, and reads easy Latin); Greek — worked out the alphabet for himself from an astronomical chart, between the ages of five and six years; French, equal to about two years in the ordinary school; German, ordinary conversation; Spanish, attended class with his mother — reads and understands; Italian, reading knowledge, simple conversation; Portuguese, asked his mother to take this language at the Columbia summer school because he could not be registered himself; Hebrew, a beginning; Anglo-Saxon, a beginning. In Astronomy he has worked out all the constellations from MacCready, and displays a very great interest in this subject. One evening this winter he noticed a new planet near the Twins. He said it was Saturn, but his mother thought it was Mars. E—— went home, worked the position out from the chart, and found it to be Saturn. He has a great interest in nature wherever found, and is already able to use Apgar intelligently. His writing is not equal to his other accomplishments. He is very slow at it, and for this reason dictates most of his "home work" to a stenographer. History is his chief and absorbing interest among school subjects. (66)

His relative shortcoming in writing is but one of several indications of a lack of dexterity in the handling of things as contrasted with his skill in the handling of the symbols of things. In the school grades reported, he received the highest grade of 1 in Industrial Arts, and the lowest grade of 4 in Fine Arts. A rather remarkable difference in the standards of these two courses is revealed in explanation: In industrial arts, credit is given for knowing industrial processes, as well as for ability to carry out the processes, whereas, in fine arts, credit is given for manual dexterity only.

He also received the lowest grade of 4 in physical education and a grade of 3 in penmanship and mathematics, although the justification of this latter rating is challenged by his private tutors.

It is further observed that he "can explain how to construct a mechanism or perform an operation clearly and minutely, though he is unable to carry out his own instructions. For instance, he can tell exactly how to make a boat, but cannot make the boat himself." There is thus an interesting distinction here between "constructive ability" and "manual dexterity." Similarly, in fine arts, the boy "has many ideas for decorative schemes, but he is unable to execute these ideas with his hands." This would seem to be a rather precarious superstructure, and is fortunately not often observed, although architects are occasionally under suspicion in this connection.

Symbols are useful as long as they stand for things

or the relations between things. If the symbolist can be provided with an amanuensis (using the term in a broader and more literal sense than implied in its usual connotation) who can check the symbols by deeds, this may be a workable arrangement in an age of specialization, but for the individual, it does not smack of a well-rounded intelligence — if indeed it passes as good education.

A few notes from a subsequent report will be of interest: In the spring of 1917, the boy finished the sixth, seventh, eighth, and ninth grades' work. He was graduated from high school in 1920 with an excellent record and excess credits at eleven years and ten months, and at this time passed the College Entrance Board Examinations and was admitted to Columbia College with fourteen points of advance credit toward the Bachelor of Arts degree. In his freshman year, he received a grade of B except in two subjects: in Physical Education, his rating was C, and in a course in Contemporary Civilization, in which his special talents would have wide play, he received a grade of A. In a report mentioned in the third chapter on a similar course called "Human Progress" at Bryn Mawr, the correlations, it may be recalled, indicated that a "large vocabulary" was especially useful. In September, 1921, he was, at the age of thirteen years three months, enrolled as a sophomore in Columbia College. One other citation is apropos the present analysis (67):

Manual work has no more charm for Edward than it had when he was eight years old. That he can work with his hands and with materials when motivated is suggested by an incident connected with the liberty bond drive. His teacher relates that Edward wanted to pay for his own bond; so he made jelly, working at it till very good jelly was made, and sold it for the purpose specified.

Dr. Hollingworth and her collaborators have figured that, at the time of the first test, the boy took a position in the frequency curve of the distribution of intelligence (of + 11 P.E.) that shows him to be possessed of a degree of intelligence which but one in a million of the population has. They conclude their report with this statement:

In these reports there is no intention to approve or to disapprove the educational regimen pursued. Who knows what should be the educational treatment of a child standing at + 11 P.E. in intellect? The sole intention is to record facts concerning the identification and development of a deviation so extreme that the chances are theoretically almost nil that it would occur at all (67).

We shall recur to the educational problem in the next chapter. Our present interest is in suggesting that the high accomplishment in the tests (as in school) is not indicative of an extraordinarily well-rounded intelligence but of the influence of a highly specialized skill that is given too much place in tests which purport to be those of general intelligence, and perhaps also in school. The situation is like that of a lone millionaire in a mill town. His dividends may so affect the average per-capita income of the town as to give

to a statistically unversed outsider a vision of community affluence.

3. *Special Abilities which are Highly Correlated with Intelligence as Tested, and Abilities which are not so Correlated*

The special abilities most commonly observed are the linguistic, the arithmetical or mathematical, the artistic or graphic, the musical, and the mechanical. Linguistic and mathematical abilities are usually highly correlated with abilities in school subjects and with intelligence as commonly tested, and the artistic, musical, and mechanical are not. The arithmetical abilities, as apart from the more general mathematical abilities, are sometimes associated with high general intelligence and sometimes appear not to be. The performances of the so-called "lightning calculators" are often cited as instances of the specialization of arithmetical abilities. The following examples given by Swift (116) are typical of these accounts:

Tom Fuller, "The Virginia Calculator," was an African slave. When first heard of as a calculator, at the age of seventy, he is said to have reduced a year and a half to seconds in about two minutes, and seventy years, seventeen days, twelve hours to seconds in about a minute and a half, and to have corrected the result of his examiner who had not taken leap years into the reckoning. He was totally illiterate.

Inundi, the Italian "lightning calculator," at the

age of seven could multiply five place numbers by five place numbers "in his head," and had an immediate auditory memory span for digits of 42. That is if a series of numbers up to 42 were read to him, he could immediately repeat them. The ordinary adult does well if he can repeat ten or a dozen without error. Yet Inundi did not learn to read and write until he was twenty.

In some of these cases, the lack of even average intelligence is, presumably, partly a matter of opportunity and lack of schooling. Furthermore, among the "lightning calculators" there are also included some of the world's great mathematicians and scientists such as Gauss and Ampère.

4. *Explanations of the Relationship between Mental Abilities*

The more general mathematical abilities as distinct from the specialized numerical skills are, on the other hand, usually correlated well with school accomplishment and intelligence as tested, but not to the extent which linguistic abilities are. We have already suggested the reasons for this relationship. These abilities are the tools of school learning and instruction and the test results are largely the effects of schooling. The converse may be suggested as the reason why the artistic or graphic, the musical and mechanical are not well related to general intelligence as now tested.

An alternative explanation which has many sup-

porters is based on evolutionary principles. For example:

> Those variants lived to transmit their hereditary constitution, whose functions were so correlated that life was well sustained. Perhaps functions are, therefore, loosely correlated where nothing would be added to the probability of survival by high correlation.
>
> It makes little difference in a world like ours whether an intelligent man can or cannot sing. It is of small moment whether one who can easily detect absurdities of statement can also produce fine representative drawings. It is very important for survival, on the other hand, whether one who can detect similarities can also detect differences in the objects which surround him, and whether he can at the same time anticipate incomplete meanings in the sentences and gestures of those whom he meets (65).[1]

This explanation seems to the writer far-fetched. Let us suppose, for instance, that drawings were made one of the tools of instruction and learning to the extent that written or printed words are now, the situation might well be very different. Success in some medical courses such as normal and pathological histology and bacteriology depend a good deal on the ability to keep in the mind's eye the differences in the character of tissues or other specimens seen under the microscope, and one of the aids commonly employed by the medical student is to prepare careful *drawings* of what he sees. Suppose that the present interest in visual education, which is one result of the development of moving pictures, should broaden so that instead of ex-

[1] Leta S. Hollingworth: *Special Talents and Defects.* By permission of The Macmillan Company, publishers.

pecting a student to *tell* what he has observed in words or to write about it, he were asked to communicate by sketches, it would not be long before the schools were as filled with "lightning artists" as they are now filled with "lightning verbalists" and "lightning calculators"; and if we then proceeded to test intelligence by sketches, as we now do by words and numbers, we should, presto, find that there was a high correlation between general intelligence and drawing.

The same suggestions might be offered for the lack of correlation between special mechanical abilities and attainment in school as well as the standing in intelligence tests. We dwelt in the fourth chapter on the intellectual character of kinæsthetic knowledge, and the lack of its recognition in school and in the intelligence tests. If it were as much a part of the media of instruction as words and numbers now are, it would also correlate well with general intelligence (as general intelligence would probably then be tested, if the scholastic influences remain as strong as they now are).

Two of the few perfect scores found in thousands of tests of children and adults with the complicated maze tests shown in Figure 19 were made by two Boston school boys who were in the "B" or lower section of a seventh grade, and who were considered scholastically dull. The finding was merely regarded as a curious one, but had such superiority been manifested in the use of words or numbers, these boys would have been singled out as boys of great scholastic and intellectual

promise, and the question would be immediately investigated as to why they were classified with a group of dull children.

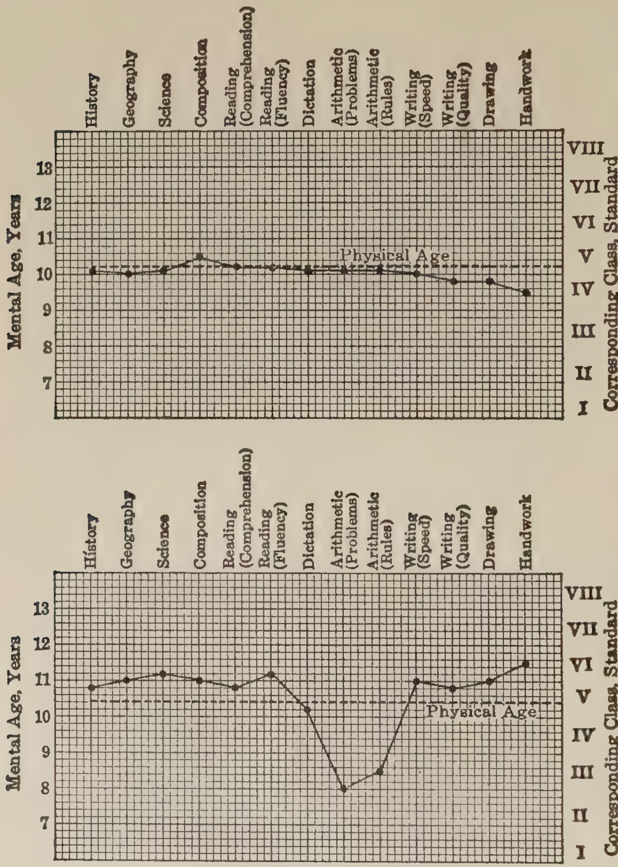
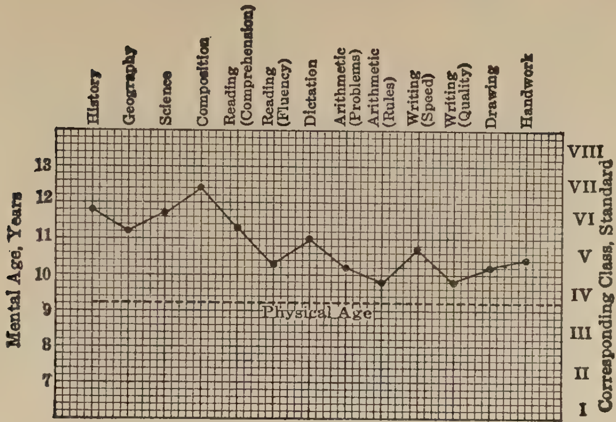


FIG. 41. PSYCHOGRAPHS FOR SPECIAL EDUCATIONAL ABILITIES (Burt)



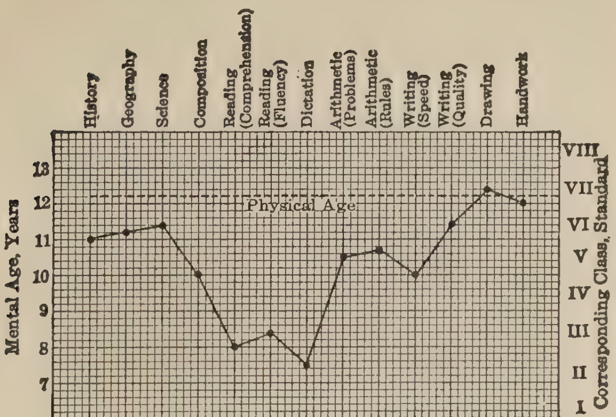


Fig. 41. Psychographs for Special Educational Abilities (Burt)

5. *The Effects of Linguistic Abilities and Disabilities on Scholarship*

The pervasive effect of a special linguistic talent in

raising, and of a special linguistic disability in lowering the general scholastic (and intellectual) level may be illustrated by the psychographs shown in Figure 41 (26). The first graph shows the moderate and evenly distributed achievements of a boy whose physical age as shown by the horizontal broken line corresponds throughout with his scholastic attainments. The second graph shows achievements which are "fair" — that is, somewhat above the average of children of the subject's age, with the exception of a special defect in arithmetic. The important thing to note is that the latter special defect does not "pull down" the pupil's standing in any other school subject. The important thing to note in the third graph is that the special ability in composition and in reading (the pupil was not so much a rapid or fluent reader as an understanding one) is associated with high standing in history, geography, and science; and it would not be difficult to maintain that this special ability had raised the level of the other school work somewhat above the average common to the subject's age. Finally, as shown in the fourth graph, a special defect in reading even in the case of an individual who, if examined discriminately, may be shown to be of average or superior intelligence, lowers the school standing in all subjects except drawing and hand work. Although such a pupil may learn much of history, geography, and science by listening to what is recited in class, in order to excel, he must, of course, read. Even in arith-

metic, if he cannot read the problems and the rules, and must depend on others to set the problems for him, he is obviously at a disadvantage.

6. *The Nature of Disabilities in Reading and their Effect on the Results of Intelligence Tests*

As special abilities in language and, to a less extent, numbers are particularly helpful in school, and special disabilities in these subjects particularly detrimental, so they similarly affect the individual's standing in the intelligence test. One of the first examples of a special disability in reading, commonly described as word-blindness, to come under the writer's attention, was that of a boy of twelve who as a result of this special scholastic handicap had on two occasions been diagnosed as feeble-minded by capable authorities, and recommended to a school for the feeble-minded. The analysis and descriptions of the nature of special defects have proceeded much further than has been the case with special talents. We may illustrate by a consideration of the phenomena of word-blindness and mirror-writing. These conditions have not ordinarily been associated in discussions of their respective etiologies. They have, however, certain features in common, a consideration of which may be reciprocally illuminating for the understanding of each condition. Word-blindness, or a special disability in reading, has until recent years remained the concern chiefly of the neurologist and the ophthal-

mologist, and has usually been regarded by them as either a congenital defect or a pathological condition due to a blight or a lesion in certain areas of the brain. Mirror-writing has, on the other hand, usually been considered a result of mere biological variation, namely, of extreme left-handedness. Although it has been more commonly observed in the subnormal, it has not been itself regarded as congenital (although left-handedness has been so considered) or pathological. The educational psychologists who have more recently become interested in these conditions have come to hold much the same point of view in regard to extreme reading disability or word-blindness as has been generally held in regard to mirror-writing. They have argued that disability in reading forms simply "the fag end of the normal distribution" of the abilities in question, have questioned the existence of congenital factors, and have considered "the possibility that inhibiting habits, however acquired, may be at the bottom of the inability."

There are quite possibly cases with no intellectual defect or shortcoming, either general or specific, where a combination of unfortunate circumstances with faulty learning may result in a disability as grave as that for which the term "word-blindness" has been commonly reserved.

Cyril Burt (27) has described such a situation:

Backwardness specifically in reading is often due to illness or absence between the ages of six and eight. It is during

this period that the ordinary child is taught to read. If he fails to learn to do so then, he is still, on the grounds of age, transferred at the usual time from the infant's department. Once in the senior school, he meets with nobody who feels it his business, or perhaps with nobody who feels himself able, to teach a child the rudiments of reading; and so he lingers on, and a few years later appears, in a very literal sense, word-blind.

It is also recognized that some early misconception or misunderstanding, especially when associated with emotional difficulties such as feelings of inferiority, may occasionally assume extraordinary proportions. Usually, however, specific intellectual shortcomings may be discovered which, even under changed conditions and the most capable instruction, condition the individual's learning. This is the thesis which is suggested by the following case studies which we shall cite, and it is in this connection that a comparison of the special difficulties of the mirror-writer with those of the non-reader is especially illuminating. The defects or shortcomings of the non-reader are perhaps often no more serious than left-handedness is in the case of a child who is being taught to write by a right-handed teacher. His differences or variations in intellectual equipment may be the starting points of the "inhibiting habits" which, after a time, make learning to read seem such a hopeless task.

If a left-handed boy gets the "feel" of the movement made by his right-handed teacher in writing the word "cat," and starting (as she does) from the

center of the body moves his left hand outward and produces the result seen in Figure 42, he will be told that he must not move his hand from the right toward the left, but from the left toward the right, and that he must watch the teacher and do as she does. He is thus required at the start to disregard his kinæsthetic stimuli and imagery, or at least to subordinate them to the visual. If the kinæsthetic feelings and memories of movement happen to be his forte (as compared with the visual), he may be doubly injured in the process of conformity which education is. Instead of the integration of kinæsthetic and visual memories which is taking place in his right-handed classmates, he begins with something of a conflict, because, while he may learn to conform in the matter of handwriting, he will follow his inclinations in other activities. The little girl who conforms to requirements in writing and in many other activities may slyly, when not under the watchful eye of parent or teacher, shift the needle into her left hand for sewing. When a left-handed boy draws a train of cars or a donkey going into a barn no one objects to his engine or his donkey facing toward his right. He will naturally draw them this way, if, as is natural, he starts with the donkey's head and finishes with its tail, because his hand will thus not obstruct his view

Fig. 42. Mirror Writing Resulting when a Left-Handed Child Attempts to Imitate a Right-Handed Teacher

during the operation. The right-handed boy or girl will usually face these objects toward his or her left hand for the same reasons. (Compare the accompanying drawings of right- and left-handed boys shown in Figure 43.) But when the left-handed boy

FIG. 43. DRAWINGS OF LEFT-HANDED AND RIGHT-HANDED CHILDREN (Dearborn)

begins to write, he must "push" his hand in a direction which covers what he has written, or adopt a position for holding his pencil which is not the correct one, and which seems and is, indeed, awkward both from his standpoint and that of the observer. An example of one such position is shown in the lower half of Figure 44. This may not appear a very serious matter, but it is of the nature of an initial handicap (85).

The initial situation of the non-reader is similar.

In the cases studied by the writer, now about twenty-five in number, at least a third have been left-handed. This is, of course, a somewhat larger proportion than would be expected in a group of otherwise normal or superior children, such as all of these cases are. The way in which left-handedness may possibly operate as an initial handicap in reading, just as it has been shown to be in writing, is suggested by the following observations. The outgoing movement of the left hand is from the center of the body toward the left. The left-handed person, possibly because he watches what his preferred hand does and thus establishes the habit, may show a preference for this same direction in his eye-movements. The reading of "saw" as "was" is a very commonly observed error, although it is not confined to the left-handed. In tachistoscopic experiments, there is a tendency for the left-handed to catch the end letters of words first, just as the right-handed commonly get the initial letters first. The reading of "when" as "now" would seem quite unintelligible except as one had observed this tendency. The mirror-writer, who will be shortly described, showed in the Binet test the curious tendency to invert certain series, as, for example, Friday comes after Saturday. In the reading test, he persisted in placing the required lines over the drawing even when it was pointed out to him that the directions called for the line to be drawn under the figure. The confusion of letters which are the same

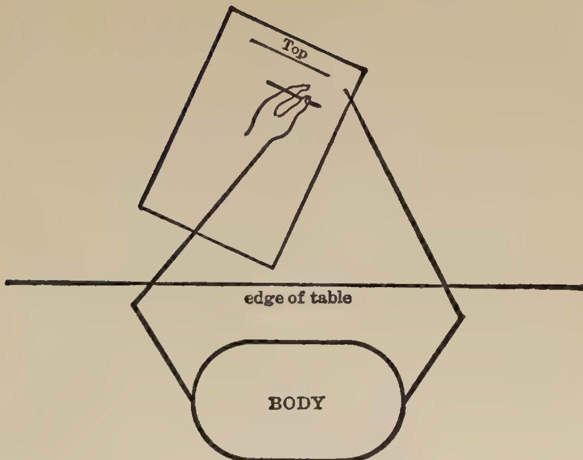


Figure 1.

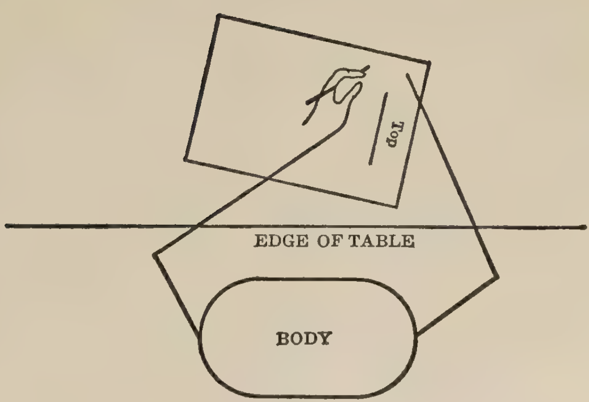


Figure 2.

FIG. 44. A LEFT-HANDED PUPIL'S POSITION IN NORMAL AND IN MIRROR-WRITING (Carmichael)

in form but different in position — such as *p, g; d, b; m, w* — has been explained as due to the fact that our earliest memories of letters may be muscular. The eye-movements may be quite as important as hand-movements in fixing these memories.

The reported greater incidence of speech defects among the left-handed also points to a further complication in their learning to read. Other individual differences are usually discoverable which may burden the first steps on the road to reading. The word "differences" rather than "deficiencies" again best describes the situation because we find either somewhat greater than average deviations, or the individual is a "tail-ender" in the distribution of certain specific intellectual abilities. If a boy's visual memory span for letters, numbers, or other signs, is somewhat contracted, the keeping in his mind's eye of a sequence of four or five letters, *or of such other cues* as are necessary for word recognition and word differentiation, may be a little more difficult (until other aids to memory are brought to bear) than for the child with a normal span; or if his auditory memory span is shorter than the average, it will be difficult for him to keep in his mind's ear the necessary sequence of phonetic elements. If added to the latter shortcomings, there is some lack in pitch discrimination or defect in articulation so that the perception and memory of sounds heard or of the movements made in speech (the glosso-kinæsthetic memory of

Bastian) are inaccurate, phonetic drill will indeed be a bugaboo. If there are faults in the foundations, the whole superstructure of reading may be imperiled. For, as Burt has remarked in the discussion above quoted, "any single mental function (as visual memory or memory for sounds) that enters as a subordinate component into the total process of reading may by its own ineffectiveness render ineffective the larger process in its entirety" (27).

These perceptual and motor difficulties are usually not serious enough in themselves to keep the boy or girl from learning to read or write, but they are, as noted, of the nature of initial handicaps to overcome which a little more than the ordinary application, interest, and motivation are required. When these difficulties are found in a child who is nervously unstable, or who from the lack of proper bringing up and discipline at home, is, at school entrance, flighty in interest, blasé, or accustomed to having his every difficulty smoothed out for him or postponed, and is, therefore, lacking in initiative, incentive, and, indeed, even in his tender years, in the very zest of living, the typical non-reader has been introduced.

7. *Disability in Reading as Related to Mirror-Writing*

These observations may be illustrated by a brief description of a case of mirror-writing,[1] and one of word-blindness.

[1] The following description is from the pen of my former student, Dr. Leonard Carmichael (85).

The mirror-writer is a boy of nine who at the time of the first examination was in the second grade of a public school. He was found to be of normal intelligence but seriously retarded in reading and arithmetic. On demand the subject can write either the normal or the mirror-script. He uses the left hand for both operations.

The positions of the body and the arms in these two sorts of writing are quite different. In fact, it seems that, while the same muscles are in some measure involved in both sets of acts, it would not be hard to believe that these two ways of writing are quite distinct habits. The two positions of the arms and body in relation to the paper in the mirror-script and the normal writing of the subject may be made clear by the two diagrams of Figure 44.

As a preliminary test the subject was asked to write a

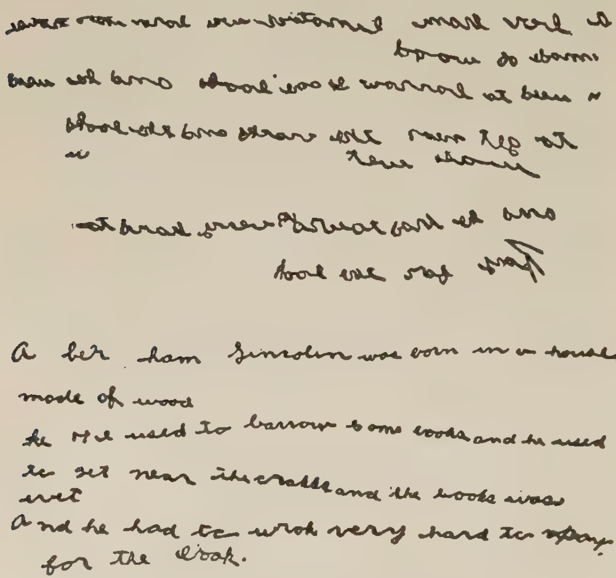


FIG. 45.

story in mirror-writing, and then to copy what he had written in direct script. It took him much longer to write the words in mirror-writing than it did to copy them in direct script. The two samples are shown in Figure 45. At a second examination he was asked to copy the following typewritten sentences:

> The big dog ran out of the house. Out in the garden he began to dig. Soon he dug up a big bone. He had hidden the bone the day before. The cook had given it to him. Now he lay down to gnaw it.

First this was copied in mirror-script with the result as seen below (Figure 46), time, 4 minutes and 10.5 seconds. He

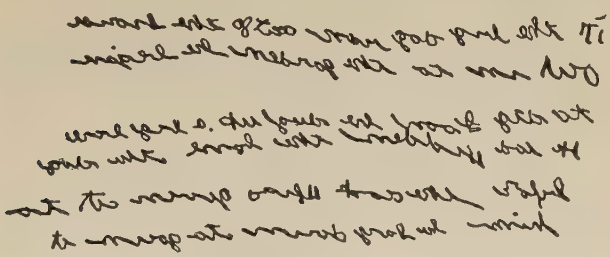


FIG. 46.

next copied the same slip in direct script in 3 minutes and 38 seconds, as shown below (Figure 47). As in the above

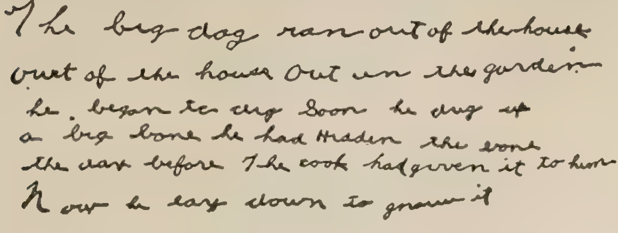


FIG. 47.

test, the direct script was written after the mirror-script, the subject was next asked to copy the following sentences first in direct script and second in mirror-writing. This was done in order to give a check upon possible practice effect. The following slip was used as a model:

> The cat lay in the barn, but she was not sleeping. She was waiting for the little gray mouse she had seen run into a hole.

He copied the above in direct script in 1 minute and 35 seconds as shown below (Figure 48). He next copied the

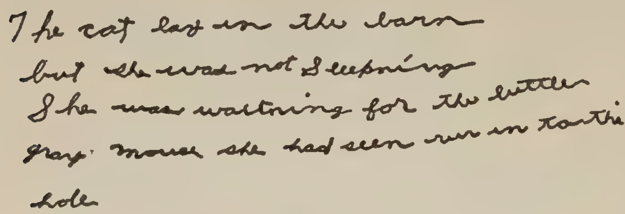


FIG. 48.

same sentence in mirror-script as shown below (Figure 49) in 2 minutes and 56 seconds.

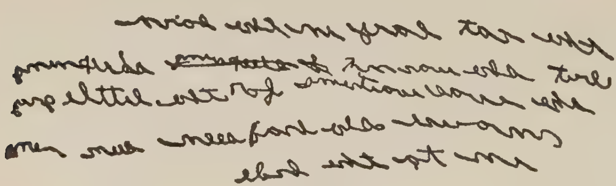


FIG. 49.

The subject's ability to read mirror-writing was next investigated. He proved unable to read any of the mirror-typewriting as shown in the sample below (Figure 50). He was able to read the words which are underlined in the slips

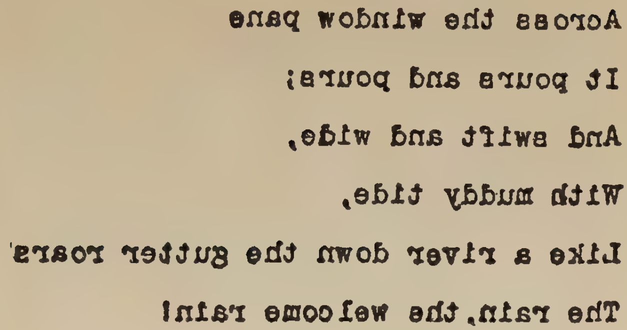


FIG. 50.

of mirror-writing which were made on "carbon paper" shown in Figure 51. At all times he was able to read his own mirror-writing.

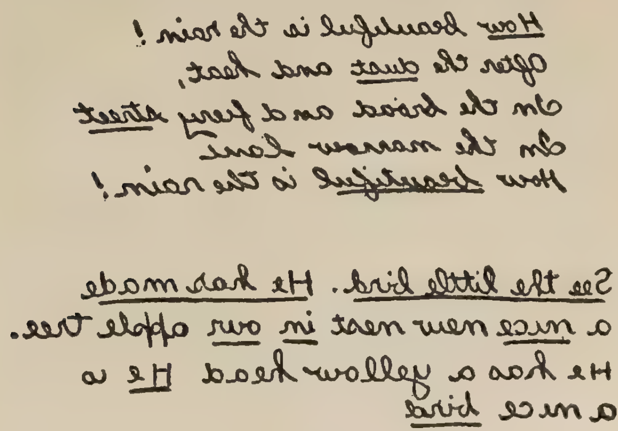


FIG. 51.

One year after the first examination, the subject was tested again. The general quality of his direct script had improved,

as may be seen in the copy of one of the same selections given above, as shown below (Figure 52), time, 2 minutes and 50 seconds.

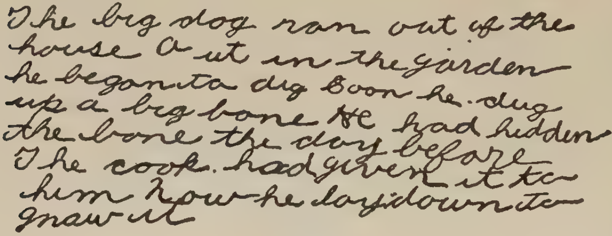


FIG. 52.

During the year between the first and the second tests, the subject claims never to have written any mirror-script. His present room-teacher (he is now in the third grade) did not know of his previous disability, although she considered him as one of her very "slow" pupils.

At the time of the second examination, it was very much more difficult for the subject to write in mirror-script than it had been one year before. The sample given below (Figure 53) is, indeed, practically the only result that could

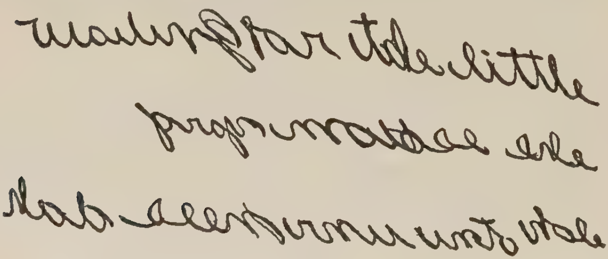


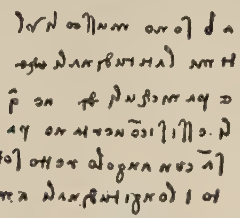
FIG. 53.

be secured at the time of the second examination. It will be noticed that not only is the quality poor, but also that the words are not all written in true mirror-script.

Although the boy had improved in writing the normal way and had also slightly improved in his reading, it is interesting to note that he did much poorer in the general intelligence examination. This may have been due to some accident of the test. On the other hand, it is recognized that the breaking of a well-grained habit may be disturbing in its general effects.

In passing, a famous example of the complete development of mirror-writing for personal correspondence will be of interest. A sample of the mirror-writing of Leonardo da Vinci (27) is shown in Figure 54.

4. Lionardo da Vinci (b. 1452), *Dell' Anatomia* (Windsor MSS. Fogli B. 15 recto. Compare also *Arundel MS.* 263, exhibited as No. 42 in Case XI in the Manuscript Saloon of the British Museum).



[Reads "a b sono mussculi ul|timi latitudinali [che]|e panichuli [di] ne q|li [*i.e.*, quali] essi si covertano pa|s(s)a con angolo retto sot|to i longitudinali a m"; *i.e.*, "*a b* are the last latitudinal muscles [that], and the membranes [from] into which they change pass at right angles beneath the longitudinal (muscles) *a m*."]

FIG. 54. SAMPLE OF MIRROR-SCRIPT USED BY LEONARDO DA VINCI (Burt)

8. *A Case of Word-Blindness; An Analysis of the Difficulties of Learning to Read*

The boy of twelve, earlier mentioned, who had been

judged to be deficient in general mental powers may be taken as an illustrative case of an extreme special disability in learning to read. Although it was soon established that he was a boy of good intelligence, and although he had been in school for six or seven years, he could not recognize with certainty even the simplest one-syllable words, with the exception of his own name, "John." In his trips to and from the laboratory, it was necessary to see that he was put in the right trolley car, as he could not recognize the trolley sign. He had certain visual defects, but in the opinion of a capable oculist, they had no bearing on his reading disability. The analysis of the special difficulties presented by the subject was made through observation of the character of his mistakes, by his response to various pedagogical methods, by the subject's spontaneously reported introspections, by the use of the short exposure apparatus, and by other such special tests.[1]

First among the possible causes of this boy's difficulties in learning to read would seem to be the limitation in his visual and auditory memory spans. His visual memory span for both letters and numbers, as tested by the short exposure apparatus, was limited to a series of three letters or of three numbers. In the tests made at the very end of his training, he was un-

[1] A more complete statement of this boy's difficulties and of the methods used in teaching him to read will be found in the account of my former student, Miss Elizabeth Lord (85).

able to read four letters or numbers correctly. At this latter time, familiar words of three letters were usually given correctly. The recognition of these words within the interval of the exposure may usually be taken as evidence that the words are read as wholes and not by means of their separate elements, although, of course, some single "dominating" or arbitrarily fixed element may still be used as the clue for the word's recognition. The subject's introspections, sometimes, however, gave support to the first interpretation, that is, that the word was recognized as a whole. If the word had only three letters he often added, "I can see it all at once," or, "I can look at three letters together." Such assurance seldom followed the observation of four or more letters.

The weakness of the auditory memory span for letters was so great that learning to spell seemed an almost insuperable task. Words of five letters, such as "table," "plant," "sieve," had to be spelled out by the teacher three or four times before the boy could repeat them correctly after the teacher. Words of six letters, such as "radish," "flower," "family," had to be spelled out ten or eleven times before the boy could repeat the sequence of letters correctly.

A second factor at the basis of his difficulties was the inaccuracy of his perceptions which can be judged by the following: although all the letters of the alphabet could be recognized when presented separately, in actual reading, "b" and "p," "m" and "n," "d" and

"b" were frequently confused. "Nest," for example, was read "most." In general, the elements of the word-form determining its perception are insufficient. The shape of the word and the initial letters were usually the chief determining factors. The filling in of the further details which were evidently necessary for correct recognition was a slow process. For example, in fixing in mind the word "house," the boy remarked, "It looks just like 'horse,' but there isn't any 'r' in it." "Mouse," he said differed from "mice" because there wasn't any "i" in it.

A word once mastered or occurring in the preceding paragraph or sentence is likely to be read in the place of similar words. His difficulties in breaking with an old association, and taking on a new one, were at times pathetic. For "on his hands and knees" the boy had read "on his hands and keys," then he corrected himself as follows: "No, knees. I say keys and look back and make believe there's no 'k' on it, because I know he didn't have any keys."

The extent to which one habit of word recognition interfered with the forming of another, as is required in the recognition of new but similar words and phrases or of changes in the word patterns, may thus be considered as a third factor in the analysis of the boy's difficulties. The words "making rabbit wool" were read "making rabbit holes." The words "rabbit holes" had been associated in a previously read story. Frequent corrections for two or three successive lesson

periods were required before the word "wool" could be attached to "rabbit." The difficulty in other cases was due to the persistence of what appears to be an incorrect motor habit, such as is acquired in the enunciation of words. The difficulty is also in part auditory. The following example will illustrate the matter: The word "few" was on first reading called "flew." It took repeated corrections and suggestions through five successive periods before, as the boy said, he could keep the "l" out, and even then it was necessary to recall the "total pattern" in which the word "few" had been fixed before he could trust himself to say the word: For example, "I was going to say 'flew,' but I said a few papers."

After a period of several months of intensive training, by various pedagogical methods, the mechanics of reading were sufficiently mastered so that, with restored confidence, the boy completed by himself the task of learning to read, finished the eighth grade at the age of sixteen, and is now in a trade school. He now reads outside of school and in school more than the ordinary boy of his age and social status. The explanation of his peculiar difficulties we trace to the sensori-motor defects just described. The establishment of the appropriate associations was thus made unusually difficult and required more than the usual drill and individual attention. Until these initial associations were formed, further instruction was not only useless, but, since it resulted in repeated failures, developed

on the part of the subject a belief that the task was indeed hopeless.

When we discover from what small beginnings or initial handicaps such extremes of disability may be developed, we are inclined to wonder whether the approach to genius through special talents may not be due to the utilization of slight initial advantages, and the dictum of William James, "genius means little more than the faculty of perceiving in an unhabitual way," gains new meaning.

9. *The Intelligence of Poor Readers*

The ability to read and write is generally regarded so all-pervasive in its effects that among the dictionary synonyms of "illiterate" we find "unlearned," "uneducated," and "untaught." If schooling were all of education, the non-reader, and even the poor reader, might indeed be unlearned and untaught. A bright child who has not learned to read may, if he is a good listener, get along fairly well in the early years of school, and may do correspondingly well in the tests of intelligence, but, with advance in grade, instruction is increasingly less by word of mouth and increasingly more by books so that the progress of the non-reader is pretty effectively blocked by the fourth grade of school, and his intelligence quotient, according to the currently used tests, decreases in proportion with his advancing years. If, at school entrance, his intelligence quotient was found to be even well over 100, it may now have

dwindled to 70, and he himself have become (in the eyes of his teachers and of psychologists) a candidate not only for the special class, but (as in the case of the boy described in the last section) for a school for the feeble-minded.

This boy from all accounts was considered quite normal at the start of his schooling. In a few instances, repeated tests of the same individual are available which also seem to show this sort of mental deterioration during the early years of schooling.

A case in point is that of a boy who, when examined at the age of eight years and seven months with the Binet tests, had a mental age of nine years and one month, and an intelligence quotient of 106. A little over four years later, at the age of twelve years and nine months, he had a mental age of eleven years and one month and an intelligence quotient of 87. This apparent decline in brightness is due mainly, the writer believes, to his failure to acquire the chief instrument for academic preferment, namely reading. It is interesting to note in this connection that his "reading age" and his "reading quotient" in the Thorndike McCall Reading Scale for the Understanding of Sentences was at this time practically the same as his mental age and intelligence quotient, namely, ten years and ten months, and 85 respectively. In the Ayres-Burgess Scale for Measuring Ability in Silent Reading, his score was at about the average of the third grade, and in the Gray's Oral Reading Tests it was nearer second grade level. His ability, as shown in the tests, is at least three or four years behind what might reasonably have been expected from a boy of his intelligence at the time of his entrance in school. During the four years' interim, he had received the best of private school training with much individual tutoring, and during the last two years he was in a "progressive" school with the Dalton plan of instruction.

The general background of this boy's scholastic difficulties is given in the following citations from the report of my former student, Dr. Elizabeth Hincks, made at the time of the first examination (63):

Jack, a boy of eight years, six months, was first seen in April, 1922. He was the oldest of three children of a successful architect and builder. The father also had great difficulty in learning to read. He did not read until twelve years of age, although he had a great deal of private tutoring. He reads peculiarly now, slowly and monotonously. His spelling is very poor. He spells phonetically for the most part, but will spell the same word many different ways. He is mechanically inclined, and does not care much for reading. He was left-handed originally. He broke his left arm, and so was forced to develop his right hand. He now writes with his right hand, but cranks an automobile, chops wood, and does other things requiring strength with his left. The mother was a graduate nurse. She says that she is a poor speller also. Jack's five-year-old sister can read already.

Jack's physical development was normal. He has always been left-handed. He has had his adenoids and tonsils removed. He has had asthma which was cured by an inoculation.

Jack's mother confessed that he was very difficult to manage. She said that he was headstrong, disobedient, affectionate, and full of energy. He plays such pranks as running all over the house and banging the doors with great force. He interferes with other people's business. He is dictatorial, and tries to direct the men who are working for his father. He is quarrelsome, and not very truthful. He has many good characteristics, on the other hand. He is unusually considerate of elderly people. He is very nice about talking to relatives who are old and deaf. He is fairly generous, is devoted to his baby brother, and shows no jealousy. His habits of cleanliness have always been good. The grandparents have been in the home a great deal, especially when Jack was a baby. It is probable that they

complicated the problem of discipline. Jack's interest is mechanical like his father's. His mother claims that he knows more about an automobile than the ordinary mechanic. He likes carpentry, and loves to hammer and saw.

School History. Jack started the first grade in a public school at the age of six. The following year he was promoted. He had whooping cough and was absent from school a great deal. As there were fifty children in the room, Jack received little attention and his promotion was conditional. The following year he was transferred to the third grade of a private school. There he got good marks in music and French but very poor marks in reading, spelling, and conduct. He was several times humiliated by being sent to read in the first grade. He came home from school purple in the face. He would only say how proud he was that his sister Mary read so well. Jack's mother was dissatisfied with the school since he was not learning to read, and very little of anything else. She transferred him to another private school which referred him to us for study.

Motor Field. On the form boards, he made very superior performances on the whole. On the Triangle, he made a 14-year score, and on the Diagonal, he made a 17-year score. His score for Healy A was only $8\frac{1}{2}$. He shows normal motor efficiency in spite of his left-handedness.

Reading. Jack showed the quick fatigability in reading that we often find among children with reading difficulty. On Gray's Oral Reading Test he read the first paragraph accurately, though slowly. The second paragraph he read a little less well. On the third paragraph, he went to pieces, making many wild guesses. His reading was slow and painful. He worked so hard to get the phonetic sound from every letter that he was soon exhausted. On the Haggerty Silent Reading Test, his score showed between the first and second-grade achievement.

Spelling. His spelling bore no resemblance to the words which he was supposed to spell. He was given the word "shirt" and wrote "hot." For "chair," he wrote "shart."

The mechanical interests and skill of this boy must

be taken into account in appraising his intelligence. The writer has been impressed by the frequency with which exceptional mechanical ingenuity is met with in these cases of reading disability. This finding might well seem to support the analysis of intelligence into abstract (or perhaps better designated as verbal), social, and mechanical abilities. The mechanical skill may, however, be simply in the nature of a compensation to atone for the failure to develop along the more accepted intellectual lines. The development of social graces and intuitions may also sometimes have a similar genesis.

10. *Further Examples of the Effect of a Special Disability on General Intelligence and Scholarship*

The history of Francis S. illustrates what may be accomplished in school, despite special handicaps, where there is the will to learn.

Five years ago, the boy was, at the age of eleven, in the fifth grade; his mental age (in the Binet Tests) was twelve years and his intelligence quotient 108. He hated reading and never read anything except what was required of him in school. He had so much difficulty in the phonetics of words that he depended mainly on the vague clues offered by the general appearance of words and could frequently give the meaning of sentences, the individual words of which he could not pronounce. His rate of reading was necessarily very slow, yet he did average work in school and, as in the case of Jack, cited in the last section, excelled in carpentry and mechanics. In the reading tests, where speed especially counts, as in the Ayres Burgess Scale, he could do no better than the average second grade child. In the Haggerty Silent Reading Test, he reached the level of the third grade.

During the last five years, the boy's rate of reading has improved but little. On the Ayres Burgess Test, he averaged fourth grade ability, and made exactly the same record in the Chapman Cooke Speed of Reading Test. He shows to better advantage, as previously, in his ability to get the meaning from the printed page: In the Thorndike McCall Reading Scale for the Understanding of Sentences he does as well as the average ninth grader, securing a "reading age" of fifteen, and, since he is now sixteen years and three months old, a reading quotient of 92. According to the results of the Stanford Binet Test, he has lost out a little in general mental development: during a period of five years and one month he has grown four years and eight months in mental years, and at the age of sixteen years and two months, has a mental age of sixteen years and eight months, and an intelligence quotient of 103, as compared with 108 five years ago. However, in a less linguistic intelligence test, the Dearborn General Intelligence Examination C, he secured (at age 16–3), a mental age of seventeen years and six months, and an intelligence quotient of 109. Best of all, in the five years he has advanced from the fifth to the tenth grade of a superior academy, is doing average work in all subjects except mathematics and mechanical drawing in which he excels the average of his classmates. In view of his persisting handicap this is a truly remarkable performance.

Had this boy been able to bring his ability in reading up to his general intellectual level, he would doubtless have shown a greater gain in intelligence, as it is commonly tested, and also in scholarship. It is usually easier to accomplish this feat at seven to eight years than at eleven to twelve, but it is often, even in the early years, much more difficult of accomplishment than is ordinarily realized. Occasionally the trick can be turned in a short time as in the following example:

Henry M. was in a fourth grade class of intellectually

superior children the average of whose intelligence quotients was in the neighborhood of 125. He was failing in his studies chiefly because he was such a painfully slow and halting reader. His mistakes were so distressing that, when called on to read aloud, his recitations were not uncommonly accompanied by suppressed groans from the class. As a result, the boy had lost confidence in his ability to do much of anything academic.

In the Stanford Binet intelligence test, he had, at age 8–11, a mental age of 9–3 and an I.Q. of 104. The comments of the examiner on the test were as follows: "The boy gave up easily; thought he could not do a great many of the tests; entire lack of confidence; seemed nervous, especially at first." His score in various reading tests was either at the level of the third grade or very low fourth grade. In the Dearborn Intelligence Examination (C and D), however, he secured a mental age of 11–7 and an I.Q. of 130. This latter test seemed to indicate capacity far beyond present accomplishment. He was taken out of the regular class work in reading and spelling, and given individual instruction in these subjects at the school by a capable tutor.

In six months' time, he made about a year's improvement in reading ability as determined by tests. In the Chapman Cooke Unspeeded Reading Comprehension Test, he had a reading age of eleven, or a rating above the average of the fifth grade and a reading quotient of 117. In the Thorndike-McCall Scale for the Understanding of Sentences, he had a reading age of ten years and one month and a reading quotient of 108. His rate of reading was still slow. What he had gained more especially was renewed confidence in his ability to carry on in school. This was reflected in a final examination with the Stanford Binet Intelligence Test. It is to be noted, that, according to the examiner, this test was given under the most favorable conditions, but it indicates, as did the earlier Dearborn test, his intellectual capacity when he is master of the situation. His score in the Binet test gave him a mental age of eleven years and eleven months, and an intelligence quotient of 126 — an increase in the six months' time of two years and eight months of mental age, and of twenty-two points in his intelligence quotient.

CHAPTER VII

PROVISIONS FOR THE WEAK- AND THE STRONG-MINDED

1. *The Intellectual Differences of Special Class Pupils*

The need for special treatment of the weak- and the strong-minded as distinct from the more common garden variety or average-minded has been implicit in various discussions of the preceding chapters, although the problem has not been explicitly presented. It is obvious that the range of individual differences in the intelligence and in the previous training of the children who yearly present themselves to the schools is so great that it is not possible, under the ordinary method of classification, to suit instruction to the capacities of all.

We have seen in the graphs of the frequencies of the various grades of intelligence that there are many individuals grouped about the central point of the range of abilities who are much alike and can be readily handled as a class, but that toward either extreme there are fewer individuals at each level of intelligence. Hence, if a class of the usual size, say of forty of these latter individuals, were formed, the differences in ability would be much greater than in a group of forty chosen from the central range. This is the reason, so difficult to explain to the lay school board but so readily sensed by the teacher, why the numbers in the

special classes of deficient or of gifted children must for equally efficient instruction be smaller than in classes of average pupils. The differences between fifteen of these children are perhaps as great as between the forty or more average abilities.

The need of segregating children who deviate greatly from the average in intelligence and experience into separate classes was first recognized in the case of the mentally deficient. This separation, it must be said, was made at first not so much in the interests of the deficient as in the interests of the normal, because the presence of the deficient pupils in the same classes with the normal children interfered with the instruction of the latter. It was the gradual realization that this segregation could not be accurately or fairly made by the then existing methods of medical and educational diagnosis which gave the chief impulse toward the perfecting of the present instruments for the testing of intelligence.

2. *The Need for Intelligence Tests in the Selection of Pupils for the Special Classes*

In 1904, Alfred Binet was appointed by the French Minister of Public Instruction a member of a commission to study the situation. This commission decided that "no child suspect should be eliminated from school and admitted into a special class without first being submitted to a pedagogical and medical examination from which it could be certified that, because of

his state of intelligence, he was unable to profit by the instruction given in the ordinary schools."

But what had the medical and pedagogical examinations to offer? Medical diagnosis was largely in terms of adult standards of economic and social efficiency, as to whether or not an individual could compete on equal terms with his more normal fellows or manage his affairs with ordinary prudence. Such criteria were, of course, of no value in deciding as to the capacities of children. The physician also had certain more or less indirect criteria — such as the family history of the same or of related disorders, the developmental history of the child, his physical characteristics and measurements, his general appearance, his behavior and speech — which enabled him to make a diagnosis in the early years of childhood of the severer grades of deficiency, idiocy, and imbecility; but for the milder grades of feeble-minded he usually fell back on the judgment of the school. So, in the language of one of the most careful statements, that of the Mental Deficiency Laws of England, the latter individuals were defined as "persons in whose case there exists from birth or from an early age mental defectiveness not amounting to imbecility, yet so pronounced that they require care, supervision, and control for their own protection, or for the protection of others; or, in the case of children, that they, by reason of such defectiveness, appear to be permanently incapable of receiving proper benefit from the instruction in ordinary schools."

But to find out who were and who were not capable of receiving proper benefit from the instruction in the ordinary schools, required a certain period of trial and the dependence on the, for the most part, unskillful judgment of the teachers. We have seen that teachers' judgments might have been greatly improved had attention been paid to the sources of their errors in judgment, but Binet preferred to make a new approach to the problem by means of intelligence tests.

3. *Are the Mentally Deficient a Separate Species?*

Furthermore, physicians had long erred in thinking that the mentally deficient could be marked off as a separate and distinct class of mortals. This notion still persists in the medical treatises on mental deficiency. Thus we read in the first edition of the text of the leading English authority of the present time (133): "It is not, however, to be assumed that amentia is merely a subtraction in varying degree from the normal. Although the contrary might be thought, nevertheless the two conditions do not merge into one another, and between the lowest normal and the highest ament a great and impassable gulf is fixed."

If this were really the case, the distinguishing between the highest ament and the lowest normal would not be such a difficult matter, and there would have been no necessity for the development of intelligence tests to supplement the judgments of teachers and physicians. Seguin, whose labors in behalf of the

feeble-minded have given him an enduring place in their short and simple annals, was one of the first to challenge this opinion. He believed that from twenty-five to thirty per cent of the mentally deficient "come nearer and nearer the standard of manhood, till some of them will defy the scrutiny of good judges when compared with ordinary young men and women." [1]

Other careful observers held similar opinions, which were shortly reinforced by the observations of anthropologists and psychologists. So that pioneer in mental measurement, Francis Galton, wrote: "Analogy clearly shows there must be a fairly constant average mental capacity in the inhabitants of the British Isles, and that deviations from that average — upwards towards genius and downwards towards stupidity — must follow the law that governs deviations from all true averages."

Galton estimated that there were 250 eminent men and 280 idiots to every million of population in Great Britain and thus concluded, "Eminently gifted men are raised as much above mediocrity as idiots are depressed below it." His estimates of a greater proportion of the lowest grades of intellect than of the supreme intellects have been confirmed by subsequent studies. The explanation would seem to be this: that there is superimposed on the general factor of biological variation the special factor of accident and

[1] This and the following two citations are taken from a review of early medical and lay opinions by Norsworthy (91), pp. 17–21.

disease which operates to increase the numbers of the very inferior, whereas there is presumably no corresponding factor to increase the numbers of the very superior individuals.

In the same vein, is the following statement of Thorndike:

> The ordinary usage of language tempts us to think that children can be divided sharply into normal and abnormal, or into hearing and deaf, or into healthy and hysterical; but ordinary observation should teach us that, within the human species, sharp lines of distinction rarely correspond to reality. Thus we know that children do not form these separate groups, the bright, the ordinary, and the dull, but there are a very few bright, others less so, others still less so, others still less, until we reach the lowest idiots by a gradual passage along the scale of intellect.

Influenced by the logic of these latter generalizations and in order to test their validity, as opposed to the prevailing medical opinion, Norsworthy, a pupil of Thorndike, made what I believe was the first adequate demonstration by means of intelligence tests of the continuity of the deviations from normal intelligence towards the extreme of mental deficiency. Her conclusions were:

> that idiots do not form a special class but belong to the ordinary distribution; and further, that this distribution is a continuous one, there being no sudden break in ability, above which we find ordinary children and below which we find the idiot, but that the decrease in ability is gradual. It seems a steady progression from that of the ordinary child, through those special cases of mentally deficient children

still retained in school, to those idiots found in institutions who can do most of the ordinary school work and seem to be not very different from children in general, on to those who can simply do manual labor, and so down through all the gradations of complete idiocy (91).

4. *The Line of Demarcation between the Normal and the Mentally Deficient*

If we wish, therefore, to make a separation for purposes of instruction between the mentally normal and mentally deficient, it must be an arbitrary one. Where can the line best be drawn? The answer is suggested by an examination of the findings of Burt's study of the distribution of the intelligence of pupils in the London schools, as illustrated in the accompanying Figure 55. This figure shows the distribution according to mental age of the children in the ordinary elementary schools and in the special schools for the mentally deficient of each chronological age from three years to fourteen years inclusive. The solid vertical lines show the total range of ability of the children examined for each chronological age in the regular schools, and the broken lines, of those in the special schools. The cross near the center of each line marks the average mental age; the arrowhead at either end the brightest or dullest child in the group. The best of the children who are grouped in special classes very evidently, as far as the tests show, equal or excel in ability the worst of the children in the regular classes. In other words, there is at each chronological

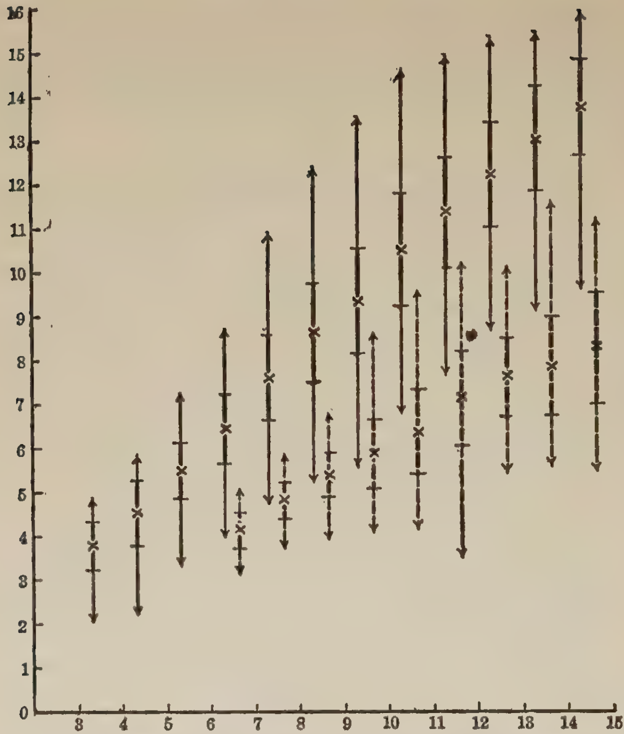


FIG. 55. DISTRIBUTION OF THE MENTAL AGE OF CHILDREN OF ORDINARY ELEMENTARY AND SPECIAL (M.D.) SCHOOLS AT EACH CHRONOLOGICAL AGE (After Burt)

The solid line represents the ordinary school children, the broken lines the mentally deficient. The means are represented by crosses, plus and minus one sigma by horizontal lines and the extremes of the distributions by arrows.

age considerable overlapping of abilities between the children in the special and ordinary schools.

If, now, each child's ability is stated in terms of a standard unit, the so-called standard deviation (or

S.D.), which expresses the extent of his deviation from the average of children of his age, it is possible to combine the distributions by ages and thus to compare the children in the regular classes as a whole with those in the special classes. This comparison is made in Figure 56. One or two of the very best of the pupils of

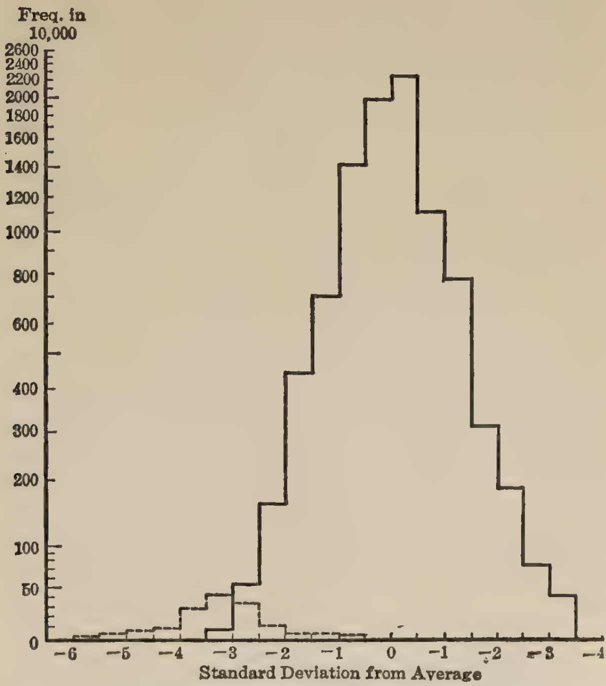


FIG. 56. DISTRIBUTION OF GENERAL INTELLIGENCE OF CHILDREN OF ORDINARY ELEMENTARY AND SPECIAL (M.D.) SCHOOLS (After Burt)

The ordinary school children are represented in solid lines, the mentally deficient in broken lines.

the special classes nearly attained to the average of the normal group, and over half of them can be matched by children left in ordinary schools and, therefore, presumably "normal." On the other hand, below the most extreme deviate of the normal group, there are found to be "no less than fifty defectives." Although it would, as Burt remarks, "strain the laws of probability and stretch the play of chance too far," to consider these fifty as simply the tail-enders of the normal group, and they are evidently to be considered for the most part as pathological, still it is also evident that "no sharp distinction . . . can be erected between the pathological defectives and the extreme specimens of 'normal' deviation" (27).

These findings lend further support to the earlier observations and estimates previously cited, of Seguin, Galton, and others — as well as to the interpretation there given them: although accident and disease swell the numbers and increase the severity of the cases of extreme deviation from the normal, they are not of sufficient moment to fix "a great and impassable gulf" between the lowest normal and the highest defective.

We thus reach again the very practical question which Burt regards as the central problem of his memorandum: Where is the cleavage to be made, or the boundary to be drawn between the normal and the defective for purposes of classification in either the regular grades or the special classes? Burt suggests that "the most natural cleavage between the two distributions is

that indicated by the point where the two curves intersect. A notched stick snaps at its narrowest part. And the two groups may be most easily severed by cutting down in the angle between the two main bulks. Here, if the overlapping branches are in reality distinct, the splicing will be thinnest" (27).

This point of intersection is found to fall at about − 2.8 S.D., in terms of the standard unit in which the distribution is plotted, below the median for the normals and to correspond with a mental ratio or I.Q. of 67 per cent. "The practical effect, therefore, of the London organization is," as Burt concludes, "to segregate the child of the special school from the child of the ordinary elementary at a level of intelligence equivalent to a retardation of about one third of the child's age." This division is also in accord with the prevailing practice in this country; an intelligence quotient in the neighborhood of 70 and below is regarded as presumptive evidence of the desirability of special instruction outside the regular classes.

5. *The Value of the Tests in the Segregation of Pupils*

There has thus been set up what is now known as the psychological criterion of mental deficiency, which has apparently been considered by some writers to be in some way independent of the earlier educational and social or economic criteria. It should, however, be apparent from this analysis that the intelligence tests do not offer an independent standard; they simply de-

fine by other means or in other terms the judgment of the school and of society — agencies that have already drawn their lines of demarcation. What the tests offer is a separate and more objective scale on which may be noted at what point these decisions have usually been made: in the case of the school the line is drawn, *on the average*, at 70 I.Q., in the case of society at 50 I.Q. The tests point to the rule in administrative procedure; they thus aid in promoting uniformity in practice, and also alertness in practice, but they do not make the rule. Nor do they discover, except for the things tested, the factors which make for the rule or for the exceptions to the rule.

6. *Other Criteria for the Selection of Special Class Pupils: the Ungraded Class*

A similar use of the educational or school subject-matter tests would give further aid in defining the point at which, by and large, segregation seems desirable. Burt has also shown that the ratio of "educational age," as determined by these latter tests, to life age is, for these borderline children, about the same as their mental ratios; in his words, "the borderline for educational ability differs but little from that of intelligence." Various other supplementary criteria are proposed to aid and define the teacher's judgment, such as have been put into effect in the operation of the recent Massachusetts law which requires the examination of children with a view to the establishment of

special classes, where there are ten or more children three years or more retarded in school. The ten fields of inquiry employed in the study of the individuals thus selected are as follows:

1. Physical examination
2. Family history
3. Personal and developmental history
4. School progress
5. Examination in school work
6. Practical knowledge and general information
7. Social history and reactions
8. Economic efficiency
9. Moral reactions
10. Mental examination

This was the plan of inquiry long employed by the late Dr. Walter E. Fernald at the Massachusetts State School at Waverley. A study of the results of his own practice (49), as reported in the accompanying Figure 57, shows that the greatest differences between those who were eventually judged feeble-minded and those who were not found to be so, appear in the examination of school work, in the test of practical knowledge and general information, and in the general intelligence test (nos. 5, 6, and 10). The most significant difference was found in the intelligence test. The intelligence tests combined with the tests of school accomplishment (especially if some account is taken of practical knowledge or general information) evidently furnish the best means of defining the judgment of the school in the assignment of its pupils to the regular or special classes.

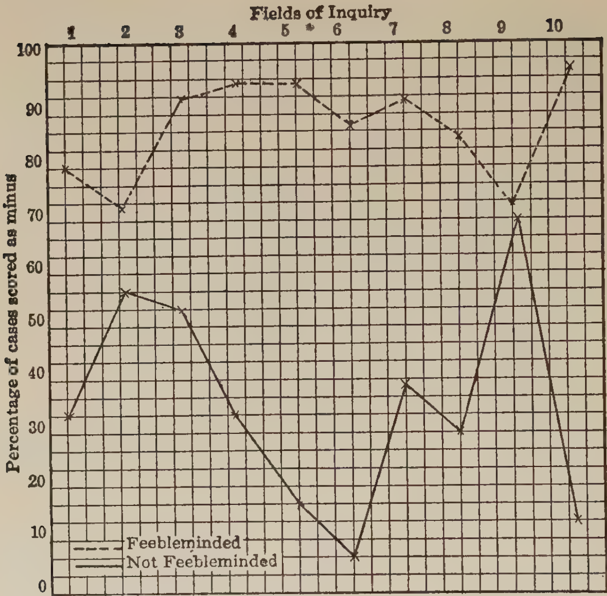


FIG. 57. COMPARISON, IN TEN FIELDS OF INQUIRY, OF CASES DIAGNOSED "FEEBLE-MINDED" AND "NOT FEEBLE-MINDED" (Fernald)

The difficulties which we have thus reviewed in this assignment of pupils have been, in good part, met in some of the larger school systems by the establishment of ungraded classes which play the rôle of a liaison officer between the special and the regular classes. These classes give opportunity, without interference with the work of the regular grade, for more prolonged observation and trial of the problematical cases on the part of the school officials. They thus promote accuracy in the final judgment. Some of the cases after

such a period of study will be returned to the regular grades, and others placed in special classes. Wallin finds that the pupils assigned to the ungraded classes usually "vary from an I.Q. of about 65 to an I.Q. of 85 or 90, and from a potential or eventual educational attainment level of from the third grade to the sixth grade, or even higher" (135).

7. *"Fitting the Child to the School" versus "Fitting the School to the Child"*

In contrast to these newer developments in administrative procedure, the traditional method of the school by which it obtained somewhat greater homogeneity of grouping out of the diversity of talents yearly presented to it, was to keep the duller pupils in the lower classes where their abilities, since they have been longer practiced, were now more on a par with those of younger and less experienced but brighter pupils, and occasionally to advance the brighter pupils into the higher classes. As, with advancing years, the problem became more acute, some of the extreme variants were eliminated from school — a procedure which helped to reduce the variability of those remaining. In order to modify the rigidity of this method, numerous ingenious schemes had, from time to time, been proposed and gained a certain vogue, schemes which may be described as methods for "fitting the child to the school" in contrast to the methods now beginning to receive trial, which may be described by the title of an excel-

lent and recent book, *Fitting the School to the Child* (72). Under the former schemes of fitting the child to the school, thc content and media of instruction remained much the same, it was only a question of ways and means of exposing the dull minds to the light of knowledge for a longer time and seeing that the brighter minds were not befogged by overexposure. This analogy breaks down in its latter half because it is not too much knowledge but too much of the same knowledge which dulls the minds of the brighter students. The various schemes are familiar to those versed in educational practices: The Pueblo Plan, which attempted to abolish class instruction, although the pupils were kept together in the same room, their individual needs were administered to by differences in assignment; the monitorial systems; the Batavia plan for supervised study and individual instruction, which required a second teacher in each classroom to keep the laggards in line, are examples of the machinery installed without essentially changing the form and content of the schools. As the first automobiles were like the horse and buggy except for the horse, so it was the same school without the class; but the new machinery was operated with no such corresponding change of power.

8. *Schemes for Varying the Rate of Progress of Pupils through School*

There were many other such innovations which

modified somewhat the form of the school without affecting its content. They were chiefly designed to admit of greater flexibility in the rate of promotion. Their names are legion. One of the first to receive attention in this country, was a scheme of promotion at short intervals inaugurated about 1870 in St. Louis. The arrangement admits of the promotion or demotion of pupils at the end of every ten weeks, the school year being divided into four quarters of ten weeks each. In a study of the operation of the plan in four large elementary schools of St. Louis (114), the results of which were presented in the first chapter (see Figures 4 and 5), it was found that about 1 per cent of the pupils finished the eight grades in four years, 6 per cent in five years, 23 per cent in six years, 34 per cent in seven years, 25 per cent in eight years, 8 per cent in nine years, 2 per cent in ten years, and about 1 per cent in eleven to thirteen years. The interesting fact about these figures, as previously noted, is that if we take the time spent in the grades as a measure of intelligence, the pupils are distributed much as they would be by the intelligence test.

Another scheme, which was called the "Double-Track Plan" or "Cambridge-Massachusetts Plan," contributed for a time nearly as much to the fame of this city as did its distinguished university. Although it has not been in operation for over fifteen years, it still attracts an occasional educational pilgrim and is described in recent texts as a going concern. It per-

mitted the completion of the last six elementary school grades in either four or six years according to which track the pupil was on or, by appropriate switchings from one track to the other, in five years. Those who could not keep on either track might still reach the terminus in seven or more years. A "Double-Tillage Plan" was another innovation which brought recognition to the town of Woburn, Massachusetts. The work of each grade was covered in the first half-year, and reviewed in the second half-year. Those who had profited sufficiently from the first course were spared the repetition and were advanced to the succeeding grade. The "Shifting Group System," the Concentric Plan, the Preparatory Center Plan — these are names of other ingenious schemes which provided varying rates of progress, and which are now replaced in popular esteem by the Winnetka and the Dalton Plans. Although some modifications of the curriculum are advocated, even the latest of these devices are primarily concerned with traversing the standard curriculum at different speeds.

9. *Classification in School by Tests*

The advent of the intelligence tests has aided in the operation of the more recent plans, and has led to an earlier differentiation of pupils than was before attempted. The common practice in most large elementary schools has been to form a class of the pupils in the order in which they came to enter the first grade,

and when the first class was filled, to open a second and a third or more classes to the next arrivals until all comers had been received. Then in the course of a year some were held back and others promoted. If the tests can anticipate this outcome, as they can in a majority of cases, no one can object to forming the various classes at the start on the basis that some will take longer than others to master the required curriculum. Some mistakes will be made and may not be as promptly corrected as they would be but for the apparent finality that is given by an objective rating in terms of mental age and I.Q. That the test is fallible, just as teachers' subjective judgments are, will be learned with further experience. The chief merit of the test is that decisions which are postponed for months and years awaiting the teacher's verdict, may now be made at the very start, and the ordering of the pupils' training made much more intelligent. In one city, Detroit, Michigan, during the first four days of school in September, 1920, 10,511 pupils who had just entered the first grade were given a group intelligence examination. On the results of the tests, pupils were classified in three groups, bright, average, and dull, called "X," "Y," and "Z" classes. Changes from one group to the other were made when justified in the opinion of the teachers. At the end of the first semester, it was found that four times as many of the "Y" or average pupils had failed of promotion as of the "X," or bright pupils, and more than eleven times as large a per cent

of the "Z" pupils failed as of "X" pupils. During the semester, about 40 per cent of the pupils had been shifted from one group to another, about 10 per cent had been shifted for other reasons than intelligence. In the judgment of the teachers, therefore, after one half-year's acquaintance with the pupils, the ratings of the pupils' intelligence, as made by test in the first four days of school, were correct in 70 per cent of the cases (16).

10. *Experiments with Classes of Gifted Pupils*

In Public School No. 64 of New York City a class of gifted pupils was organized in 1916 on the basis of individual tests. Five different classes were established in the next few years doing work from the second grade to the eighth grade. About 100 children have been sent from these classes into the high school, and at the time of the report now being reviewed (72), there were 125 children in these classes. For the total group of about 250, including a few children who have been in and out of the classes, the range of intelligence quotients is from 110 to 180. There was but one individual included in the group with an I.Q. of less than 115 and but one with an I.Q. of over 175. Leaving these two cases out of consideration, the range in intelligence quotients of the remaining 99 per cent of the pupils is from 115 to 175, or a total range of 60 points. It may be recalled that, in a previous chapter, we showed that the ordinary range of intelligence quotients in the

grades of typical communities about Boston is from 50 to 150, with an exceptional pupil above or below these points. In other words, the usual range is about 100 points of I.Q. If we consider only the middle 50 per cent of the cases, we find that, in the ordinary classes, the pupils in this middle group differed from each other by about twenty points. In the case of this group of 250 exceptional pupils, the range of the middle fifty per cent was less than 15 points of I.Q. The life ages for the entire group are not given, but judging from the ages which are given for the first class of 25 children in which the total range of ages was but three years and the range of the middle fifty per cent but a little over one year, the range of the mental ages of this group as a whole was also less than that of the regular classes. These statements show that, although we are considering a group of exceptionally gifted pupils, they form for purposes of instruction a more homogeneous group than that of the regular classes. The achievements of these children justified their grouping into separate classes. It was expected that the gifted child would do better school work in a class of his peers than when left to the less stimulating environs of the regular class, and these expectations were borne out. A survey of the academic achievements of these children proved that they were greater than those of children of equal ability in other New York schools where they were scattered among the various classes.

11. *Problems Met with in the Classification of Gifted Pupils*

The removal of the gifted children from the regular classes has been thought to have an unfortunate effect on the teachers and on the pupils who are left behind; without the "star" pupils the class becomes dull and uninteresting to the teachers and the pupils miss the leadership and incentive of the example of superior accomplishment.

Quite apart from the fact that the gifted child has some rights of his own in these respects, it must also be noted that, if the pace-maker is much too fast for the runners, the effect is discouraging rather than stimulating. One or two children who are always first with the answer and who receive an undue share of the praise may lower rather than raise the morale of the rest of the class. Leadership is, after all, a relative matter. As for the teacher of the regular class, the experience of his confrère of the special class should be sufficiently reassuring. The degree of satisfaction which these latter teachers find in even the meager progress of their charges is a matter of frequent and surprised comment. The observers of the New York City experiment report that, as a matter of fact, the teachers were not only generous in giving up the gifted pupils, but found quite adequate compensation in watching, with pride, the subsequent careers of their pupils through the grades and the high school.

In a special opportunity class for gifted children,

organized in 1922 in Public School No. 165 of New York City, only children (with a few exceptions) with intelligence quotients of over 160 and between the ages of seven and a half and nine and a half were sought. The segregation was made with the design of seeing what could be done both educationally and socially by keeping the group together for at least three years. The problem which this class hopes to solve is indicated by the following statement:

There were several children in the school who were obviously misfits in any regular class; as for instance Lz, a sturdy little boy of seven, mental age twelve, at that time completing the fifth grade. Surrounded by boys three or four years older than himself, larger, stronger, with more mature social instincts and far less intellectual interest, such a child finds himself more or less isolated among his fellows. Shut out of their games as a "baby," regarded in the classroom as a prodigy, or derisively dubbed "Professor," he is deprived of the normal companionship of his age. And yet, had he been held back with the seven-year-olds, he would have had as little in common with them. His school work, moreover, would have been so easy for him, success so effortless and praise so constant, that only by a miracle would boredom, laziness, and conceit have been avoided (34).

A class of twenty-five children who were as much out of place in the regular classes as was this boy was eventually formed.

The expectation is that, in three years, these children will complete the remainder of the New York elementary school curriculum, with three years of French, and one of Latin and algebra, and with much more extensive work in literature, history, and the elementary school subjects which may

be grouped under the social and natural sciences than is usually attempted (34).

The various considerations governing the use of the intelligence tests in the later elementary grades of the regular school organization are graphically illustrated by Figure 58. The plan is in successful operation in the schools of Providence, Rhode Island (3). It is an ingenious chart but perhaps no more ingenious than the plan of work it illustrates.[1]

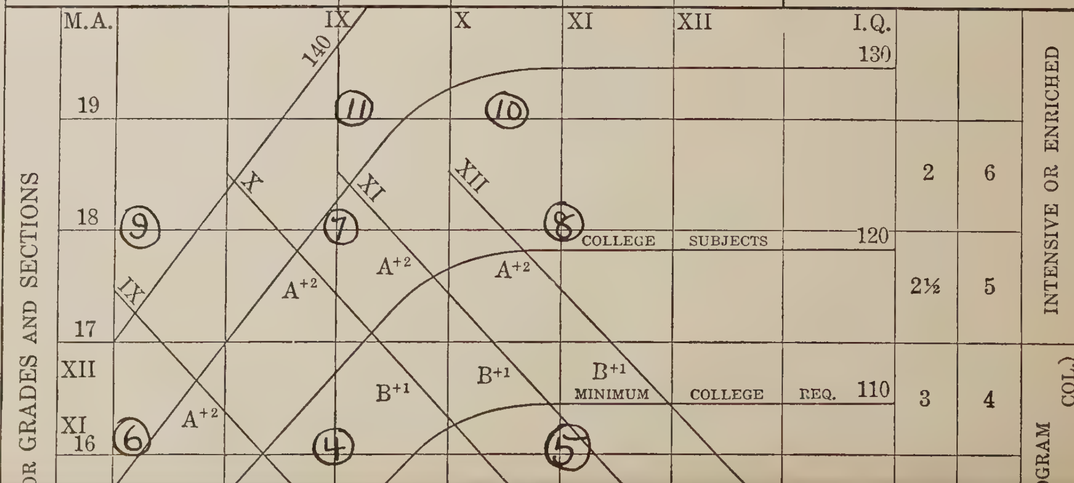
From the child's location in the chart, which is determined by his chronological age and his mental age (the numbers encircled in ink represent individual cases), certain conclusions are drawn as to the time he is likely to stay in school, how far he is likely to go, or how far it is wise for him to attempt to go, and what had best be done for him during the remainder of his course in the way of a differentiated, enriched, or specialized education.

One of the purposes of the junior-high-school organization is that a child may have the opportunity of experimenting and trying himself out. Too frequently, because of administrative difficulties, he has been forced into an early decision as to his subsequent course of study. The intelligence tests may aid in these decisions, but, because of their scholastic limitations, they should only aid and not be the basis of the decision.

[1] Figures 58 and 59 are reproduced from charts supplied to the author through the courtesy of Dr. Richard D. Allen, Director of the Bureau of Research and Guidance of the Public Schools of Providence, R.I.

THE PROVIDENCE CLASS PERSONNEL CHART SR.H.S. GRADES 10-12
SHOWING CH.A., M.A., I.Q., ACHIEVEMENT LEVEL, AND GUIDANCE PROGRAM
FOR EACH PUPIL

EXTRA SUBJECTS	1	½	EXTRA SUBJECTS FOR ACCELERATION ONLY			SCHOOL any High Sch
EXTRA CUR. ACT.	10	10	10	6	2	GRADE 9B SECTION all
ELECTIVES COL.	2	2	1	0	-1	ADVISER
ELECTIVES VOC.	2	2	3	4	5	DATE



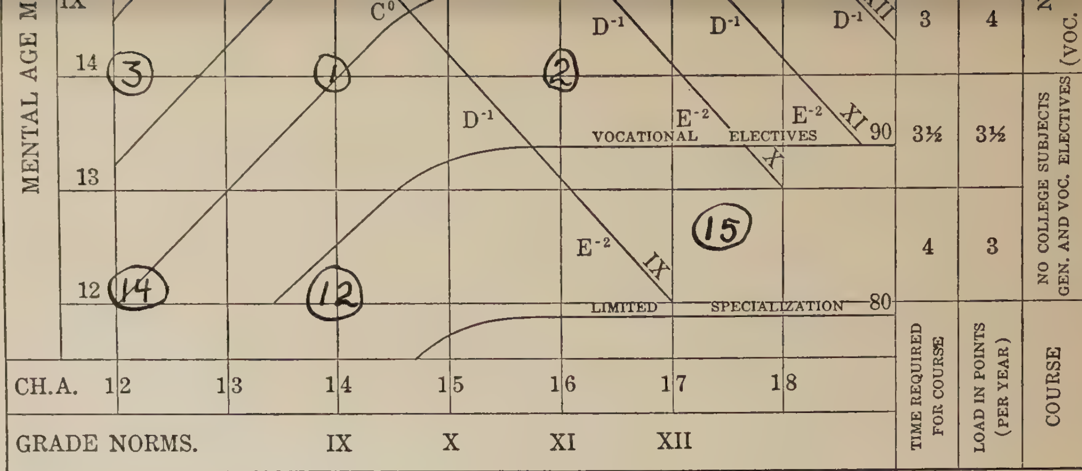


FIG. 58. FACTORS WHICH GOVERN THE USE OF INTELLIGENCE TEST SCORES (After Allen)

PURPOSE

The Class Personnel Charts attempt to translate the measurements of pupils into programs of individual adjustment and guidance. They also constitute a measurement of both grading and classification.

EXPLANATION

The numbered horizontal lines indicate mental ages, the numbered vertical lines represent chronological ages, and the numbered oblique lines, curving into horizontal lines, locate the intelligence quotients or various rates of mental development. The educational implications of the M.A. and C.A. of each pupil are indicated in code at the top and at the right of the chart. They apply to Grade X only.

The straight oblique lines, marked with Roman numerals and letters, indicate the achievement levels for the various grades. These show what each pupil should be able to achieve, since they represent the median achievement of pupils of the same mental age.

RECORDING

If the M.A. and C.A. of a pupil are known, locate the point representing his C.A. at the bottom of the chart and move vertically upward until the point horizontally opposite his proper M.A. is reached. Indicate the point by a spot or by a serial number. The pupil's I.Q. can be estimated with reasonable accuracy by the perpendicular distance between the I.Q. lines. No table, slide rule, or figuring is necessary.

If only the I.Q. and C.A. are known, proceed as above except that the I.Q. of the pupil rather than his M.A. will determine the exact point of vertical location. His M.A. can then be estimated between the proper horizontals.

Further aid may be secured by a knowledge of the pupil's home equipment, physical equipment, and educational equipment. An example of such an individual study is shown in Figure 59 (3).

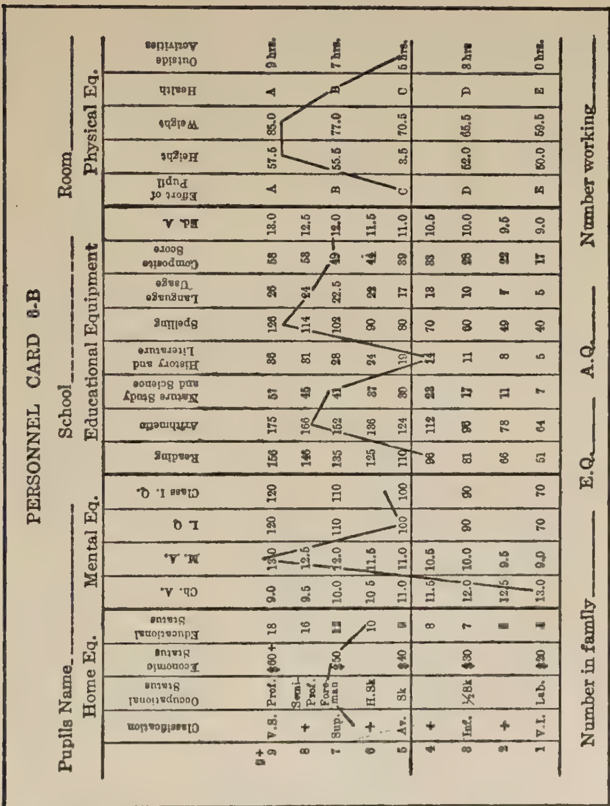


Fig. 59. Chart for the Study of a Child's Home, Physical, and Educational Equipment (After Allen)

These various examples illustrate the way in which the intelligence test has aided or extended the operation of the numerous schemes by which, with one variation or another, attempts have been made to provide for greater flexibility in the school organization. These schemes have affected the form or organization of the school and the methods of instruction, but have in no fundamental way affected its content — that is, the subject-matter of instruction.

12. *The Curriculum of the Special Classes: An Adventure in Education*

The first really important modification of the school curriculum came as a result of the organization of classes for the mentally subnormal children. Although those who advocated the organization of these classes did so in the belief that these children needed a different sort of curriculum, even they scarcely realized the importance of the departure, or that their efforts would eventually benefit the instruction of all school children. It is perhaps not too much to say that, for the first time in public school education, the child rather than the curriculum became the chief object of study. *The Child, His Nature, and His Needs*, to suggest by a single title, that of a recent contribution to education (92), the far-reaching results of this effort, became the center of interest. The course of study was subordinated to the child. Instead of inquiring how best or how fast can the child master the standard cur-

riculum, the inquiry became: How much of the present curriculum, or if not any of it, what sort of a curriculum is best suited to the capacities and the needs, personal, economic, and social, of the individual pupil?

The lack of constructive interest (as distinct from a charitable interest) on the part of the ordinary schoolman in these classes, except as a means of promoting the welfare of the regular classes, has had the advantage of allowing for freedom of experimentation, but has had the disadvantage that, with a few notable exceptions, the classes have been so handicapped from lack of financial support that the ideals of a *different* education from that of the regular schools have been but partly realized. Even though these classes have not had a fair chance, the superiority for the mentally deficient children of the sensori-motor, manual, and industrial training over the academic pursuits of the regular classes is no longer in doubt.

When one observes what has been accomplished by such curricula at the Massachusetts State Schools at Waverley and Wrentham, and at the New York State School at Rome (15), to cite but three outstanding examples, it must be apparent that the accomplishments of the special classes fall far short of their possibilities.

13. *The Problem of the "Three R's" in the Special Classes*

The difficulty of breaking with educational tradition

still leaves a too great emphasis in these classes on training in the three R's. The intelligence quotients of the special-class children usually range from 50 to 75. Some of the more poorly endowed can hardly, if at all, master the mechanics of reading after years of labor, and but few of the better intellects can make use of reading. It is thought by some that the literary instruction has more value as mental discipline than hand work, which may be doubted, but the reason, outside of the resistance of the profession to any change, is a social one. These children must also eventually find their place in life, and, in the mind of the parent and later of the child, the one indication of culture is the ability to read, and the lack of this acquirement stigmatizes the child almost as much as a gross physical defect. Although these children may never read more than a few signs or simple directions, they may have caught the meaning of reading, and feel that they have entered into their due heritage. Huey (71) in his *Psychology and Pedagogy of Reading*[1] recalls "how Livingstone excited the wonder and awe of an African tribe as he daily perused a book that had survived the vicissitudes of travel. So incomprehensible, to these savages, was his performance with the book, that they finally stole it and ate it, as the best way they knew of 'reading' it, of getting the white man's satisfaction from it."

The special-class children have acquired a better

[1] By permission of The Macmillan Company, publishers.

taste for reading than this, and their situation is not so different from that which may result from other academic disciplines. The college student of Greek whose knowledge of epigraphy is not sufficient to enable him to decipher an inscription which he has come across in his travels has at least the satisfaction of knowing that the epigraph is Greek and not Sanskrit, and, as a traveler in foreign lands, does not feel quite so much "out of it" as he might otherwise feel. With this example in mind, we may find at least as much justification for reading in the special classes as for Greek in college. On the other hand, as Woodrow (139) reminds us:

> There are innumerable examples like that of the boy who spent seven years in one of the special classes in Cleveland, after attending the regular grades for three years. At last he was triumphantly able painstakingly to write such words as "my," "see," and "dog," but unable to read them after he wrote them. His "education" cost the city one thousand dollars. Not to apply our knowledge that instruction in the three "R's" in such cases as these is utterly futile, now that we have by a costly experience gained that knowledge, is criminal folly.[1]

14. *Feeble-Minded in School, Able-Minded out of School*

The significance of what is really *special* in the instruction of the special classes is that it fits for the niche which the pupil may fill in life better than does the instruction of the regular schools. The latter re-

[1] Herbert Woodrow: *Brightness and Dullness in Children.* Philadelphia, Lippincott, 1919.

quire, as we have seen, for even a satisfactory start at least an I.Q. of 70, but the occupations which this individual may, with proper training fill, and with the utmost satisfaction to himself and society, do not require any such intelligence — at least of the sort tested. It has now been clearly shown by studies both in this country and abroad that there is a marked difference between psychological and economic criteria of mental efficiency. Children who are three years or more retarded in the public school classes, and who by the prevailing standards of the psychological examinations would be adjudged feeble-minded, are able after leaving school, in a surprising proportion of cases, to support themselves and to manage their affairs under the prevailing economic conditions with ordinary prudence. An intelligence quotient of 70, which has commonly been accepted as the arbitrary point of demarcation of the feeble-minded in so far as psychological tests can contribute to such a demarcation, is evidently too high. An intelligence quotient of 50 or under, at least as secured by these tests, squares better with the social and economic criteria by which the feeble-minded are ordinarily differentiated.

With the training which the special classes can give, particularly if the devoted teachers of these classes were encouraged to pursue their work with an eye single to their real mission, the graduates of the special class, however they may have been considered in school, need not and will not be regarded as feeble-

minded or defective when they take their places among the workers of the world.

15. *The Intelligence and Training of Continuation School Pupils*

There is another group of children whose need for special provision has as yet been barely recognized, namely, the continuation school pupils. Hopkins, in a study recently published under the title of *The Intelligence of Continuation School Pupils in Massachusetts* (70), has examined about twelve hundred continuation school pupils in five Massachusetts cities and towns and compared them with about two thousand pupils of the same ages in the regular schools of these communities. Different types of racial and industrial centers are represented. Two of the communities have a fairly homogeneous racial group and few industries employing a high type of skilled workmen (automobile body, boot, and shoe); a third city is very heterogeneous as to race and diversified as to industries; the fourth is a typical cotton mill city; the fifth city is in the metropolitan area, and differs from the others in including pupils in its continuation school from a number of surrounding communities. The findings in these varied communities were much the same: The intellectual development of continuation school pupils is, on the average, about two and a half years less than that of the regular school pupils of the same age; about a quarter only of the con-

tinuation school children exceed the 25th percentile of the regular school distribution (in terms of mental ages), and a smaller proportion reach the median or average age of the latter groups.

These findings were obtained by the use of group intelligence tests, somewhat less linguistic and academic than many but still with some of the limitations we have previously discussed. However, the differences found are too great not to be without significance. Certainly not all of the difference between these groups can be attributed to heredity. It is in part the effect of schooling. The intellectual development of some (how many no one knows) has suffered because the schools have not provided the right sort of training for them. The usual academic training has failed where there is good reason to believe training of a different sort might have succeeded. Prevocational and trade classes would have helped, but admission to such classes usually depends on the completion of at least the work of the sixth grade, and that is just what these children have not been able to do. With the remarkable increase in recent years in the enrollment of other junior and senior high schools, the enrollment of the trade and technical high school has, in many communities, remained static. If these schools would come down from their high places and suit their instruction to the needs of this group, their ranks might be filled. The sciences basic to the art of plumbing are numerous, but they should not estop a plumber's helper in the making.

Whatever the merits of this suggestion — and the writer is aware of some of its complications — here is a group of children at least half of whom have been seriously retarded because of this inability to learn well what is ordinarily taught in the fifth and sixth grades. Is there no other alternative to keeping them in these and lower school grades until they are 14 years of age? And should not these considerations give pause to those who, without providing measures to meet existing difficulties, advocate the keeping of these children in school by legal measures, for a year or two longer?

The attention to the needs of the special groups of the more deficient and scholastically backward pupils has come only indirectly; they interfered with the progress of the normal group and were either segregated or eliminated before they received consideration. Attention to the needs of the specially gifted is coming about as a more directly conscious effort on the part of schoolmen, and the intelligence tests have done much to clarify the problem for them. We have already described some of the beginnings of this movement, we cannot conclude our consideration of it without again referring to the limitations of the academic tester and the academic teacher in whose hands the direction of this important educational advance now largely rests.

16. *The Discovery of Genius and its Education*

It may take a genius to recognize a genius in the

budding, and it is to be feared that intelligence tests have not yet reached the stature which will admit of their substitution for genius. In an earlier chapter, we were at pains to show that the intelligence tests, as at present constituted, recognize chiefly the sort of abilities which are preferred by the school and college. The college awards the crown of laurel to the students who subsequently become its professors of Latin and Greek and of the modern languages. They are its geniuses, and this, or the more generally scholastic, is the only type of genius the intelligence tests are now capable of recognizing.

The college fails to crown, when they are students, the men who subsequently attain eminence as writers, composers, artists, scientists, and men of affairs, and although it attempts to atone for its lack of perspicacity by awarding them in subsequent years all sorts of honorary degrees and distinctions, it is not the college which discovers their talents. Such, I fear, will also be the fate of the present intelligence tests.

And supposing that the tests have caught the genius, what will the school do for him? Despite the abortive attempts of the last fifty years, it may now, with the advent of the tests, keep him more unerringly with his intellectual peers and offer him more rapid advancement. The dangers from this course of social maladjustments have been unduly dreaded; equality of intellects is quite as important as equality of physiques; and this course would not be so difficult

were the intrenched positions of the socially and physically favored in the American school and college first undermined. Those who fear the outcome with its various possible complications advocate enrichment and less scholastic speed. But enrichment with what? Their proposals are chiefly of more of the same curriculum.

Rapid transit through school would seem preferable to many of these personally and more leisurely conducted academic tours, at least for some species of potential geniuses. Oswald (93 and 94) believes that the students who cannot be kept on the rails, or those who, not content with methodical teaching, make out their own itineraries, are the ones most likely to have within them the seeds of genius. In his intimate study of the intellectual development of some of the world's greatest scientists, he observed that, as youths, they usually showed distaste for the formal instruction of the schools and that for them the linguistic and, in general, classical education was particularly ineffective. In speaking of their teachers, he quotes the remarks of a distinguished head master of an English public school to the effect that while a classical or mathematical teacher improves with age, since he perfects himself in the methods of teaching these less progressive branches of learning, "the science masters cannot but deteriorate unless they keep abreast with the progress of science by increasing its bounds by their own efforts." Those who do thus keep abreast would

seem, through the example of their own creative efforts, most likely to kindle the fires of genius in their pupils. And as to the duration of school life for the genius and perhaps for some others, Oswald remarks: "Had Kelvin or Leibnitz been so unfortunate as to have come into the world in our days, and in Germany, their early development would have been of no avail; they would have sat on the school benches till their eighteenth year — an age at which they had gained a prominent position in science." As it needed an Itard, a Seguin, and a Walter E. Fernald to find ways of enriching the minds and lives of the feeble of intellect, so the educational world awaits a Moses who will lead the intellectually gifted into the promised land.

CHAPTER VIII

INTELLIGENCE, SCHOOLING, AND BEHAVIOR

1. *A Psychological Statement of the Doctrine of Original Sin*

The term "moral" or "criminal imbecile" has been used more frequently in the past than at present to describe an individual who is believed to have been born with defects of character as well as with defects of intellect. This belief is part and parcel of a general psychological theory which also is fortunately becoming less generally held. Psychologists have, for example, spoken of "inborn impulses to cruelty," "inherent ill-temper," "constitutional sensuality," "hereditary nomadism" or the "migratory instinct" as the cause of truancy, and the "instinct of hunting" as the incentive to predatory acts. These are no more than statements in psychological phraseology of the doctrine of original sin, a doctrine discarded, as the writer understands it, by the majority of theologians, and for which the psychologists have as little evidence as had the theologians. Without minimizing the effects of the physical make-up of the individual, of his possible organic deficiencies or excesses, defects of character are being accounted for more in terms of learning than of inheritance, and misbehavior traced more to differences in dispositions which are acquired rather than innate. Those who still hold to the doc-

trine of original sin in its psychological form usually believe that learning can for the most part overcome the inheritance, but the job of education is made doubly difficult if the born wicked must first unlearn their sins before they learn righteousness. The task of education is not so immense if the individual has only to learn and not first to unlearn.

In commenting on the cases of "Three Problem Children" whose histories have been recently published by the Joint Committee on Methods of Preventing Delinquency in order to show what can be done by the home, the school, and society for delinquent children, a distinguished educator and practical schoolman writes: Boys of this type are usually "eliminated before reaching high school. They appear later either as successes in life and lasting reproaches to education, or as criminals or semi-criminals, depending probably upon their individual types of inherited instinctive equipment. Quite possibly [this boy's] father was of the type last mentioned" (142). Thus complacently would the educator sidestep his share of responsibility for the outcome. So if acts of violence, destruction, and sabotage in the industrial world are attributed to the individual's lack of the instinct of possession, and of workmanship or construction, and his possession in full measure of the instincts of pugnacity, self-assertion, and of the herd, it would appear that the family, the school, and society are remiss only in not having prevented these un-

fortunate results. The possibility that the individual may have learned these responses under the tutelage of the family, of the school, and of society would hardly be entertained by those who suppose themselves to be possessed of such an accurate inventory of the individual's unfortunately inherited or instinctive equipment.

There is just as much reason for saying that the instincts are neutral and that the environment makes vices or virtues out of them, as that instincts determine the result. Neither position is, in fact, tenable, and the names and phrases cited above are descriptive of the combined effects of nature and nurture. "Characteristics, as such," as Jennings (74) has recently stated with great clarity and convincingness "are not inherited at all, what one inherits is a certain material that under certain conditions will produce a particular characteristic; if those conditions are not supplied, some other characteristic is produced." The influence of a given home may make, in the case of a certain native equipment, a vicious outcome likely; even society at its best may in the rare case be ill-ordered for the functioning of some inheritable factors, as that resulting in oversexedness; for it should be noted that this is a name not of the inheritable factor alone but of a condition to which both nature and environment are contributory.

2. *Delinquency as due to Hereditary Reactions*

The implications of much of the current psychologi-

cal analysis of delinquency are contrary to this thesis. Thus Burt (28), from whose contributions to the measurement of intelligence we have drawn much aid and comfort, seems to err in his account of the origins of delinquency and crime. He finds that juvenile offenses may be classified according to the "precipitating motive" under six categories: sex, anger, acquisitiveness, wandering, grief, and secretiveness. And he adds that these categories correspond to the usual classifications of human instincts. From this "unexpected parallel," he infers that juvenile delinquencies consist either of hereditary reactions or of slightly modified reactions which are elaborated out of and spring from "these aboriginal modes of response." Had he made a list of the virtues of youth, he could equally well find the precipitating motives in some of these categories. From such classifications by themselves, one learns nothing about the distinctive characteristics of either crime or virtue. Since it is the environment that decides which ones out of a multiplicity of potential characteristics shall come to fruition, we can only argue about differences in endowment when we find differences in conduct under what appear to be essentially the same environmental conditions.

3. *Statistical Studies of the Relation of Intelligence and Delinquency*

Those who have been so well convinced of the individual's natural depravity have found further support

in their associated contention that the delinquent was also an imbecile and therefore not possessed of sufficient intelligence to have come to such a pass by learning. The application of intelligence tests by many investigators in the early part of this century to the inmates of the prison reformatories and other penal institutions seemed at first to uphold this contention. One investigator reported that "probably eighty per cent of the children in the Juvenile Courts in Manhattan and the Bronx are feeble-minded." Another, after an examination of the inmates of the New York Reformatory for Women, reported that practically all were feeble-minded. "Sixty-six per cent of the cases of the Newark Detention Home are distinctly feeble-minded" was the conclusion of another report. But with a gradual recognition of the numerous pitfalls into which the unwary investigator and theorist in this field may tumble, each succeeding report became more conservative. "The best estimate and the result of the most careful studies," so read a later report, "indicate that somewhere in the neighborhood of fifty per cent of all criminals are feeble-minded." "Practically one third of our delinquent children are feeble-minded," is another statement. The majority of the statistics of a decade ago reported that from thirty-three to fifty per cent of the criminal and delinquent were feeble-minded. Popular opinion and the again unwary investigator interpreted these figures as indicating that intelligence was a most, if not *the* most,

important factor in determining the behavior of the individual, whether for good or bad, forgetting that, in the first place, these statistics were based only on the delinquents who had been caught — and, therefore, presumably on only the most unintelligent delinquents.

4. *What Proportion of Delinquents are Feeble-Minded?* A wider sampling of the population through studies of Juvenile Court cases, and of the potential delinquent, the disciplinary cases and the truants of the public school, has reduced these estimates to less than ten per cent. For example, a recent study by one of my students (64) of three thousand children who were three years or more retarded in the public schools of Massachusetts found that twenty per cent were reported as disciplinary cases. Only eight per cent of these latter children have intelligence quotients below 70. Exactly the same proportion of the juvenile delinquents tested by Burt in England with the Binet-Simon tests were found to be mentally deficient, or, to use his phraseology, "backward in intelligence by at least three tenths of their ages" (28). It is at this level that the arbitrary line between the normal and defective is ordinarily drawn. But, as was shown in the last chapter, there is a marked difference between the psychological or scholastic and the economic or social criteria of deficiency. The school failure and the test failure, after leaving school, are in a large proportion of cases able to support themselves

and manage their affairs with ordinary prudence. An intelligence quotient of 50 squares better with these latter criteria. However they may have been considered at school, the majority of children above this level will not be regarded as feeble-minded when they take their places among the workers of the world. Such considerations still further reduce the estimates of the relation between feeble-mindedness and delinquency. In fact, in a number of recent comparisons between the ratings of certain institutional groups and the ratings of the drafted men in the army, as made with army intelligence tests, no important differences can be recognized.

Table 11 is an example of such a finding (12).

TABLE 11. INTELLIGENCE RATING IN THE ARMY ALPHA TEST OF 197 DELINQUENT GIRLS

RATING	PER CENT	PER CENT OF 94,004 DRAFTED MEN
A .....Very Superior	0.5	4.1
B .....Superior	3.0	8.0
C+.....High Average	14.7	15.2
C .....Average	25.4	25.0
C−.....Low Average	26.9	23.8
D .....Inferior	17.3	17.0
D−.....Very Inferior	12.2	7.1

There are about eight and a half per cent more individuals in the superior and very superior classes of the drafted men than in the corresponding delinquent groups, and about five per cent more delinquent girls are classified in the inferior and very inferior than there

are of the drafted men so classified. Another recent study using the same method reports the median score of over three thousand criminals in institutions to be the same as that of the army draft. These latter studies may upon more critical analysis be shown to misrepresent the situation somewhat. For example, we should expect the intelligence rating of the young offenders to be higher than that of the older simply because on the former the effect of schooling, such as it is, has been less modified by the lapse of time. We have already in many connections shown the extent to which standing in the intelligence tests is affected by schooling. On the other hand, the influence of schooling must also be kept in mind in interpreting the estimate of approximately seven or eight per cent of feeble-mindedness among juvenile delinquents, upon which a number of investigations in this country and abroad are in substantial agreement, because these studies also show that the delinquent is nearly twice as backward in his scholastic attainments as in his general intelligence as tested. In other words, had he profited more by schooling he would not be so unintelligent. Finally, as noted, this conclusion as to the percentage of feeble-mindedness is based on the assumption of a 70 I.Q. as the line of demarcation, but less than a third of the school feeble-minded are certifiable as feeble-minded when adults — that is, to repeat, the line of demarcation should have been drawn by these investigators at 50 I.Q. instead of 70. We

thus arrive at an estimate of perhaps not more than three per cent as the proportion of feeble-minded among the juvenile delinquents; the proportion among recidivists and some other classes of the adult criminal population is undoubtedly larger. Recent statistics, however, of the New York State Prison at Sing Sing show that nearly five per cent of the newcomers were college men, nine per cent high-school graduates, and forty-eight per cent had passed the fifth grade of school. The percentages of the population of the State of New York which have had these amounts of schooling can hardly be greatly in excess of these figures. We do not maintain, therefore, that mental deficiency bears no relation to crime, but only that it is not as important and, as we shall now proceed to point out, not as necessary a relation as has been supposed.

5. "*Affective*" *Deficiency as the Cause of Crime*

The contention, then, that the lack of intelligence is evidence that the criminal is born and not made, cannot be upheld. Quite undaunted by this trend of statistical findings, those who are possessed of the notion that it is in inheritance that we must seek the source of our woes, are now accounting for delinquency and crime by a new formulation of the doctrine of original sin, namely, the inheritance of an emotional or affective deficiency. This condition used to be described as emotional or temperamental instability, and there is evidence, to which the intelligence tests have at least

indirectly contributed, that this condition is also quite as much a matter of learning as of inheritance.

6. *The Proportion of Delinquents in the "Dull-Normal" Group*

In the study of children three or more years retarded in school, to which reference has been made (64), the following percentages of disciplinary cases were discovered: 30 per cent among those who had I.Q.'s of over 100, 53 per cent of those having I.Q.'s between 85 and 100, 15 per cent of those having I.Q.'s between 70 and 85, and 8 per cent of those having I.Q.'s below 70. The largest percentages were thus found in the groups bordering on the normal. In all the cases with I.Q.'s of over 100, the retardation was caused by a language handicap, or by a special disability in some one subject. These children were thus required to sit through the school day associating with intellectually inferior classmates and performing tasks which were, for the most part, far below the level of their ability.

The distribution of intelligence quotients of delinquent girls in one of the State institutions of Connecticut is shown in Table 12 (12). It may be noted in passing that, although 20.9 per cent of them are classified as defective, if the line of demarcation were drawn at 50 instead of 70, as we have shown it should be, but a fraction of one per cent would be considered feeble-minded. Nearly half of the cases are in the

TABLE 12. THE I.Q.'S OF 311 DELINQUENT GIRLS

I.Q.	Cases	Percentage	Class	Percentage
41– 50......	1	.3	Defective	20.9
51– 60......	13	4.2		
61– 70......	51	16.4		
71– 80......	75	24.2	Borderline	24.2
81– 90......	76	24.5	Dull	24.5
91–100......	48	15.5	Normal	22.9
101–110......	23	7.4		
111–120......	23	7.4	Superior	7.7
121–130......	1	0.3		

groups of dull normals with I.Q.'s between 71 and 90. Similar findings have been reported by Dr. William Healy (62) in regard to the intelligence of juvenile offenders coming before the Juvenile Court in Boston. It can be seen from the distribution of intelligence quotients reproduced in Figure 60 that the large majority of cases are in the I.Q. range of 70 to 100.

Burt (27), in his studies of the delinquent among the

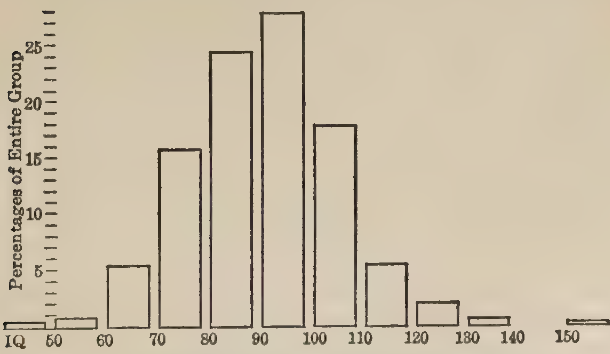


FIG. 60. DISTRIBUTION OF THE STANFORD-BINET I.Q.'S OF 1212 JUVENILE REPEATED OFFENDERS (Healy)

London schools, finds "7 per cent only are on or below the verge of mental deficiency (that is below an I.Q. of 70), one fifth are definitely retarded, nearly one half fall slightly below the average; one quarter are approximately equal to the average, and 2 per cent rise slightly above"; and he concludes that "the majority of juvenile delinquents thus appear to be technically 'backward' but not technically defective," and adds a recommendation that we shall find every reason to support, "the association of juvenile delinquency with educational backwardness provides in itself a strong motive towards making special provision for the backward child during his school career."

So also, Berry (17) finds in a study of conditions in the public school of Detroit that "not only are most of the mentally retarded not delinquent" (he finds less than twenty per cent of them are "behavior problems"), "but the largest percentage of delinquency is found, not among those most seriously retarded mentally, but among those of less mental retardation."

7. *Protecting the School Dullard: Experimental Approaches*

What is the significance of these and similar findings which are now being reported in regard to juvenile delinquents? In the study of the disciplinary children of the Massachusetts schools, it was discovered that the majority were over age and socially unsuited to their grades. They were regarded as being in a position

where adjustment is particularly difficult. Allowance is made for the failings of the clearly recognized defective, but in the case of this group, no particular recognition of its intellectual shortcomings is made. The attitude of the school is that if these pupils were only sufficiently prodded they could be brought up to scratch. Their response to this treatment is responsible for their classification as disciplinary cases, and, in good part, for their truancy. Poull (101), in a study of New York City truants, makes similar observations:

> It will be found that the largest percentage of truants are neither belonging to the class now recognized as definitely defective nor to the class of average normality. But rather to this questionable group lying between these two classes, ranging from the arbitrary line of 70 per cent at the lower end to the equally arbitrary line of 90 per cent at the upper end. It may be assumed that they have, added to a lack of intelligence which placed them at a definite disadvantage with their chronological compeers, an amount of insight that makes it impossible for them to rest content with the unsuitable school environment as do the more definitely defective children.

If the school should provide an education better suited to the abilities of these pupils, it would give the added blessing of protecting their dispositions. This is, of course, not alone a school problem, much can be accomplished by aid in the pre-school period, and there is some warrant for such a statement as that of Berry's made in connection with the above-quoted study that "if those in charge of special education regard their domain as not extending beyond the school, the work

is doomed to failure," yet, while it may be desirable to cast the mote out of the parents' eye, the ordinary ethics of the proverb requires that the beam should first be removed. And there is no question but that the school's view of this problem has been obscured. In this particular case, it may even be doubted whether mere backwardness causes as much trouble at home as it does at present at school. However this may be, the discouragement of repeated failure in school, the lack of the satisfactions which come with successful effort, so react on the morale that capable observers believe these attitudes to be important factors in the causation of delinquency. We have already stressed the fact that the intellectual requirements for occupation outside the school are really less than within the school, and that society provides greater opportunities for the employment of intellectual abilities of the level of these children than does the school. Some of these children first acquire feelings of competence and habits of contented industry when they take their places among the workers; others find it difficult to establish such healthful attitudes toward life, *partly* because the school has cultivated the opposite habits of mind in them. If the tasks of the school were better suited to individual abilities, more of these children might face the world, not with the feelings of inferiority, incompetence, and even of resentment which now handicap them, but with confidence in the usefulness of such abilities as they possess, and with friendly feelings toward those

whom they serve. Such assets as these are but the by-products of a good education. It may thus appear that inferior intelligence need offer no barrier to a sweet disposition, and that temperamental instability does not flourish within healthy environs.

What can the school do for this group of children? We have seen that the academic courses of the upper grades and of the high school are closed to them. The opportunities of the special classes are for the recognized defective. The trade schools want for the most part only the successful students who might go into high school but prefer the trade school chiefly for economic reasons. Their doors should be opened to this group of pupils, as we have seen that they should also be opened to those who later become our continuation school pupils. For these schools, teachers should be found whose academic interests are not so exalted as to make sciences out of the arts and crafts. Some of the reformatory schools offer curricula more suited to the abilities of these pupils. If the reformatory schools were incorporated as a part of the equipment of the fourth to sixth grades of our city schools, they might not be needed for their present purposes.

A small but significant experiment in one of the New York schools points the way out of these difficulties (72). Many other similar experiments are now in the making. A class of 5B grade boys was chosen for the experiment because it was known to contain so many boys who were difficult school problems. It first pro-

vided but a single hour a day in the school work-shop. As fifth graders, these boys were not eligible for this privilege, they were not over well received by those in charge, and at first, the pupils were not particularly interested; but the attitude of condemnation soon changed as their products found place among the best in the shop's exhibit. The only other innovation which it was possible to arrange was the addition of a swimming class. As a result of these two small beginnings, the change of spirit of the boys is described as "little short of remarkable," because they had a chance to do in school some things which they liked and some other things at which they could succeed. At the end of the second year of this experiment, truancy and disciplinary problems had practically been eliminated. The actual figures for school absences were as follows: in the second term, 573½ days, and 182½ days in the fourth term.

8. *Similar Problems at Home*

The problem of misbehavior and delinquency and its prevention or correction is, of course, not wholly one of the schools. Although it is on that phase of the matter we have chosen to focus attention, it may illuminate the presentation of the problem to recall other like situations outside the school. A child of average intelligence who is brought up in a brilliant family which is set on making a corporation lawyer out of him may be just as badly off. The gibes of his brighter

brothers and sisters, some of whom pass him in school, and the frantic efforts of his parents to raise him above his intellectual level sometimes result in a very distressing family situation. Or a child who in intelligence, or, because of better educational opportunity, is superior to his parents may sometimes, it would seem for no other reason, turn out badly. This situation is occasionally observed in a well-educated child of foreign-born parents; the latter's lack of understanding of many of the everyday problems of school and of life outside the home may be taken advantage of by the child. Having long and successfully asserted his superiority to the family circle and circumvented parental authority, he may make the mistake of thinking that the world in general should as readily succumb to his dictation or cunning. Or, to return to the school situation, a special intellectual defect, such as described in a preceding chapter, is frequently associated with family and school maladjustments. The analysis of what is cause and what is effect is not always easy. The non-reader, for example, whose history was first set forth, was a great disciplinary problem at school. There was no reason to trace his difficulties to the home or to hold the school especially responsible, and when he was finally taught, or to put the matter more accurately, when he had, with some tutorial aid, finally learned to read, nothing more was heard of his other difficulties, and his present teachers as little suspect him of having for long been a

Table 13. The Present Location of 470 Patients who have been Discharged from the Massachusetts State School for the Feeble-Minded (143)

Earning a living without supervision	28
Working for wages, supervised at home	86
Working at home, no wages	77
Living at home, not able to work	59
Arrested but not sentenced	23
Sentenced to penal institutions	32
Committed to other institutions	43
Readmitted to Waverley	68
Died	54
Total	470

school terror as they are ignorant of the fact that he was for long a confirmed non-reader.

9. *Education for Character: The Effects of Institutional Training*

What it may be possible for the school to do for the dull normal group from whom are recruited the majority of offenders against the school, and subsequently against society, may be appreciated by considering what it has done for those who are much more severely handicapped intellectually. There are altogether too few studies of what schools have been able to do or even what the better institutions have accomplished — not so much by way of education in the narrower sense, but in education for life.

Table 13 presents the results of a study of 470 patients who were, during a period of twenty-five years, discharged from the Massachusetts School for

the Feeble-Minded. The record, in view of the earlier histories of a great many of these individuals, is truly a remarkable one, and is to be attributed to the effects of education in its fullest sense. What might have been accomplished with those who were only potential offenders is a chapter which will one day be written. The following statement summarizes the report:

> The results of this survey should be interpreted with great caution. As a rule, the most promising cases are allowed to go home. They have received careful training. The parents have been properly instructed. Still, many unpromising cases did well. There was a surprisingly small amount of criminality and sex offense and, especially, of illegitimacy. We may hope for a much better record when we have extra-institutional visitation and supervision of all discharged cases. Those with definite character defects, especially those with bad homes, should be discharged with great caution. The survey shows that there are bad defectives and good defectives. It also shows that even some apparently bad do "settle down" (50).

A subsequent study of "one hundred institutionally trained male defectives in the community under supervision" shows not only the extent to which the individual may become self-supporting if given the proper training, but also to what an extent he will be well behaved:

> Of the one hundred boys of this study, only three have been arrested. One was returned to the school, and the other two were sent to reform schools. With the exception of the one boy returned to Waverley, none of these boys has done anything of an immoral nature. All but two of the adults in this group have been self-supporting and most of them have helped in the support of their families. It is

noticeable that after a boy's training has made him an asset to his family, his people become interested in him and co-operate in his supervision. These one hundred boys have been living in the community for from ten months to five years. Most of them have been out of the school between two and three years. At present, when the pressure for admission for young, teachable boys is so great, this community supervision for older, trained boys makes it possible to admit those who so much need this training and who otherwise might become delinquents.

This brief study shows that, with few exceptions these boys have made good. Their success seems to be due to the painstaking, constructive training received while at the school, and to proper supervision after going out into the community. We feel that, with continued friendly, helpful supervision free from humiliating circumstances, the average feeble-minded boy, properly brought up and trained to work, can live in the community and play his part there (88).

And still another report from a Massachusetts Out-Patient Clinic reads:

As to the inferior normals, almost without exception, we were able to make them happier and better off by easing up the standards of achievement in school, in social life, or in work, which ambitious guardians had expected them to live up to. Too much had been expected of them also. One boy of nine, with an eight-year mind, was most incorrigible in the fourth grade in school, but when dropped back to the third grade, his badness disappeared and he became happy and contented. The maladjusted normals were often found to be bored with their studies in school, or were nagged by neurotic parents or were otherwise misunderstood at home, or were at work at uncongenial tasks, or did not have a needed variety of interests and recreation. Several children, most incorrigible under home conditions, created by parents with no understanding of the primary needs of childhood, promptly began to behave properly and normally when taken from home and placed in a selected family with wise management (51).

10. *Education for Character: The Effects of Training in the Special Classes of the Public Schools*

A study by Woolley and Hart of 203 feeble-minded ex-school children also shows at least the possibilities of education. Although these children had been in the Cincinnati special classes on the average for only a year and a half, they had been somewhat elevated from the social background of alcoholism, delinquency, and disease from which they sprang. Over two thirds of these children came from families which had needed the assistance of the city's agencies for social and physical betterment or been before its Juvenile or Adult Courts, whereas but one third of the children had come before the court.

In two cases, delinquency developed before the child reached the special school; in 45 cases, delinquency was in evidence during the child's attendance at the school, or just at the time of leaving; in 27 instances, delinquency developed after the child left school (some of those in this group having been delinquent during their schooling also) (140).

About seven tenths of the boys were gainfully employed or in the army or navy, and practically six tenths of the girls were either gainfully employed or married. The important conclusion of the report is this:

The importance of selecting children for special classes as early as possible in their school careers has been vividly demonstrated in this study. The only hope for them is to train them up to good habits and normal social reactions by beginning as early as possible. If the special school does

not get them until adolescence, as was the case with most of the present group, its possibilities of accomplishment are very much limited. Feeble-minded children are peculiarly creatures of habit. If good habits can be ingrained in early childhood, they may become law-abiding citizens. If bad habits are ingrained, it is almost impossible to change them. The hopeful feature of the situation is that it is almost as hard to change the good as the bad habits in adult years (140).

In a subsequent report by Anderson, which viewed the outcome four years later, the following were the findings:

Approximately half of the 298 cases are gainfully employed in industry, and are providing no particularly serious social problems for society (all of this without the exercise of any serious effort at supervision and aid by the community). If this can be said of an unselected group of feeble-minded persons for whom society has made no special provision in the way of industrial and vocational training after care and supervision, then what may we not accomplish under a purposeful plan and comprehensive program? (4.)

In a report of one special class teacher who had carefully followed the careers of her children for over a period of ten years, but 13 out of 174 came in any way to grief. Their schooling had been supplemented by such solicitous watchfulness as a busy shepherd can give a flock which has been sent to market, but these considerations hardly lessen the significance of this example of what may come out of special classes in the way of education.

If these things can be done for the defective, what the schools may do in alleviating the problems of de-

linquency and crime is limited only by the efforts which may be put forth. At present, the conclusion must be faced that, with all their benefits, they are contributing to the difficulties of at least one group — the dull normal. When reformers advocate didactic moral instruction in the school as a remedy for existing conditions, we may well reply that it is example rather than precept which the school should offer its pupils.

CHAPTER IX

EDUCATIONAL DETERMINISM AND SOCIAL POLICY

1. *The Determination of Intelligence by Education*

The emphasis which has been given in the previous chapters to the influences of schooling and environment on intelligence may appear to the reader as unwarranted as the more common emphasis on individual endowment or nature. Indeed, the above presentation is admittedly a reaction against the dogmatic statements which, in accounting for the differences which subsequently appear in the intelligence, behavior, and attainment of individuals, attribute so preponderating an influence to that which is inborn, and so determined at, or long before birth. In justification, we shall not recount the expectations or promises of altering pre-natal or post-natal conditions which experiments in the physiology of the glandular or internal secretions may hold forth, nor repeat the vagaries of a Berman (14). The contributions to human betterment from this source have, as yet, been disappointingly small as compared with the expectations which they have aroused in the popular imagination (38). We shall, however, refer to some observations and experiments in the neurology of the central nervous system, which perhaps justify the assigning of greater

importance to the extrinsic or environmental than to the intrinsic or native factors. Our thesis has been that it is not possible with present knowledge to differentiate precisely the relative effects of nature and nurture on human intelligence. In this contention, we are but extending the earlier criticisms of the Belgian psychologists Decroly and Dégant (141), who first stressed the influence of social status and educational opportunity on a child's performance in the tests, and of the Italian psychologists Trevis and Saffiotti, who questioned the existence of such a thing as "pure intelligence," and remarked that "intelligence develops under the influence of the milieu." To them, the "whole concept of mental age and 'pure intelligence' had no psychological significance and little pedagogical importance so long as these cultural factors were ignored" (141). As we have previously remarked, intelligence does not develop *in vacuo*.

2. *Nature is but a First Habit: Neurological Experimentation*

Neurological experiments and the corresponding developments in psychological analysis tempt one to go a step farther. Educators have long appreciated the significance of the profound truth that was presented so forcefully in the writings of William James, that habit is second nature. In the light of these developments, there is now added reason for completing this familiar statement, as Rignano (104) has done, by

adding that, on the other hand, nature is but a first habit. The experiments of the Dutch neurologists Kappers and Bok (22), although in need of some further confirmation (31), seem to show that the very architecture of the nervous system is determined by function, that its growth is determined by the forces which play upon it. Nervous connections are first established between simultaneously stimulated regions. In psychology, the patterns of behavior, or instincts, which have been regarded as inherited, as well as intelligence, may similarly be accounted for on a single fundamental principle of habit-formation. If we can modify the conditions under which an organism develops, we can determine its habits and hence its nature. Yet, even if there is thus no fundamental distinction between what has been called innate and what has been called acquired, the possibilities of education may appear as limited as before this conclusion was reached. By the time the child reaches school, he may be quite as much predetermined by his previous learning as the determinist has assumed him to be by his native endowment. All of which may be true of the individual of six years, but if society wished, it might find ways which, under the old assumption were not so promising, for making an earlier start at what it is pleased to call the individual's formal education.

These considerations may not seem to recognize the existence of individual differences in the vitality or vigor of the organism, which is a notion at the very

core of the concept of differences in native intelligence. In order, however, not to dwell further on these problems, we may make the usual proviso, and, assuming a healthy organism, assert that by controlling its habits we may in large measure determine its intelligence.

3. *Determination by Heredity: Interpretation of the Results of Testing in the United States Army*

For Professor Bagley, whose protests against the assumptions or presumptions of the intelligence tester precipitated one of the recent tempests in the educational teapot, "educational determinism means the attitude of mind consequent upon the conviction or the assumption that the influence of education is very narrowly circumscribed by traits or capacities which for each individual are both innate and in themselves practically unmodified by experience or training" (8). We need not refer to the particular statements to which he objected, since similar statements equally to his point have been cited in our previous discussions, such as, for example, that the quality of intelligence is born with one and can neither be improved by schooling nor dulled by neglect. Whipple, in the teeth of the storm, published as his credo that there exist fundamental and relatively permanent individual differences in intellectual capacity which are in the main inherited, and which the tests measure. A particularly bald statement is this of Franzen: "A

child of ten has the same intelligence as he had at three, though he has attained greater mental growth by that time."

Whatever may be said of the belief in a fixed intellectual capacity which is inborn, the assumption that the tests can separate it and measure it quite apart from environmental effects is, as we have seen, unwarranted. This was the regular, if not regulation, assumption in the interpretations of the results of the testing in the United States Army. Brigham, in his *Study of American Intelligence* (23), provides an extraordinary example of it. He found that the more recent immigrants who were in the army draft were less intelligent, according to the army tests, than those who had been longer in this country. There was a steady increase in the scores corresponding to the length of residence in this country. The foreigners who had been here twenty years equaled, on the average, the scores of the native-born. Brigham, on the assumption that the tests measure the native intelligence, concludes that the earlier immigrants were more intelligent, and that, with each succeeding period, the immigrants coming to this country have been of steadily decreasing quality. An equally obvious explanation is that the more recent immigrants, who were in the draft, had come over practically as adults, and their acquaintance with the American language, customs, and culture was most limited; whereas those who had been ten, fifteen, or

TABLE 14. A COMPARISON OF THE AMOUNT OF SCHOOLING AND THE ARMY ALPHA SCORES OF DIFFERENT GROUPS OF DRAFTED MEN (LIPPMANN)

Officers with	14.7 years' schooling made median score of 139.2
Native whites with	6.9 years' schooling made median score of 58.9
Foreign whites with	4.7 years' schooling made median score of 46.7
Northern negroes with	4.9 years' schooling made median score of 38.6
Southern negroes with	2.6 years' schooling made median score of 12.4

Thus in the case of

Officers	A year's schooling was worth roughly 9.46 points on intelligence score
Native whites	A year's schooling was worth roughly 8.53 points on intelligence score
Foreign whites	A year's schooling was worth roughly 9.93 points on intelligence score
Northern negroes	A year's schooling was worth roughly 7.87 points on intelligence score
Southern negroes	A year's schooling was worth roughly 4.76 points on intelligence score

twenty years in this country were younger at the time of their arrival and had been longer exposed to American culture and hence did better in American tests, which, in fact, were in good part tests of American culture.

Another example is the interpretation of the differences between the rating of officers and various sections of the draft. That differences in schooling, whatever the differences in native intelligence, had something to do with the results would certainly be suggested by the tabulations shown in Table 14 (84).

The measure of schooling is admittedly a rough one, namely, the number of years spent in school. The officers, who had the highest median score, had, on the average, nearly three years of college, or 14.7 years in school; the native-born white draft had, on the average, not quite seven years of schooling, and the Southern negroes, who stood lowest in the tests, had had but 2.6 years of schooling. If we now divide the score in the tests by the years spent in school, we reach a rather interesting result. A year's schooling was worth to the whites, whether officers or privates, natives or foreigners, about the same number of points toward their intelligence scores. It was worth less to the negroes. The fact that a year's schooling was worth more to the Northern than to the Southern negro may be interpreted as indicating important differences between Northern and Southern schools, which differences surely exist, or as showing that the Northern

negroes are a selected group and, as such, intellectually superior to the Southern negroes. Mr. Lippmann, who presented these comparisons in an article on "A Defense of Education" (84), makes the following comments on them:[1]

> There were then three conceivable ways of interpreting these facts. The psychologists could have said that in general the more schooling, the better the score. They could have said that while schooling alone did not determine the score, it was certainly a powerful influence. Either interpretation would, however, have knocked out their claim that the tests measure native ability pure and simple. They have, in fact, chosen to argue not that schooling affects the scores, but that the scores indicate how many years of school each group was *capable* of completing.

A similar choice of interpretations is suggested in a recent article by Herbert Alexander (2), in which he compares the ranks of the various American States in the Army Intelligence Examination with their social and economic status. In one of his comparisons, he makes use of a rank order of the efficiency of the school systems of the American States arranged by Ayres on the basis of certain significant facts about the schools, such as the percentage of the school population who attend school, the number of school days in the year, the average annual expenditure per child and per teacher and for other school purposes. Alexander finds a coefficient of correlation of .72 ($\pm$ .05) between the rank of the States in the Ayres Index in the year

[1] Reprinted by permission of *The Century Magazine*.

1900, at which time the average draftee of the army was of school age, and the rank of the draftees from these various States in the Army Intelligence examinations. This comparison indicates that the better the educational advantages in a State, the more intelligent are its citizens. This result is, however, susceptible of at least two interpretations: either "that the States having the better stocks build the better schools," or that "an excellent educational system is a great factor in the unfolding of intelligence." Alexander's conclusions from this and certain other comparisons which he has made are "that, where density of population, favorable economic conditions, and educational opportunities exist in conjunction, there will be found the better intelligence."

He summarizes his findings as follows:

> When the average position for each of the forty-one States is found from the rankings or per cent of urban population, ownership of farms, average wage for farm labor, literacy, and Ayres' school systems, and the correlation of this combined rank order is made with Alpha, the resulting coefficient is $.89 \pm .02$. Our conclusion is that, in so far as it applies to such large social groups as the American States, Army Alpha appears as a test of what *has* been learned rather than what *can* be learned.

Figure 61 presents graphically a similar comparison of various sections of the country. Their rank in the army tests is shown in the first column of figures on the left and their rank according to the Ayres Index in the second column of figures. Lines are drawn between

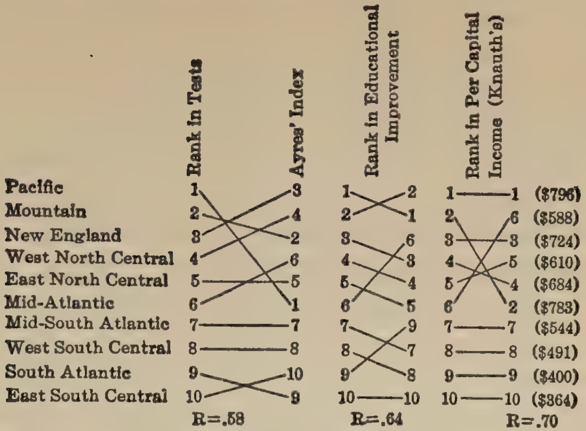


FIG. 61. INTELLIGENCE TEST SCORES MADE BY DRAFTED MEN FROM DIFFERENT SECTIONS OF THE COUNTRY COMPARED WITH PER-CAPITA INCOME AND WITH SCHOOL SYSTEMS

The data for this chart were taken from the article by Walter Lippman, in *The Century Magazine*, May, 1923.

the figures in these two columns to show the correspondence between rank in the tests and rank in the Ayres Index. The East-North-Central group of States was, for example, fifth in rank in both, the groups ranking seventh and eighth in the tests also held this rank in the Index. The largest difference was in the ranking of the Pacific States. The rank coefficient of correlation between standing in the two arrays is .58.

In the next two columns of figures, the ranking in the tests is compared with the relative improvement in educational conditions which has taken place in a recent decade. The correlation is somewhat higher than

in the first comparison. Finally, if we compare the rank in the tests with the average per-capita income of these sections of the country, we find an even higher correlation, those sections first, third, seventh, eighth, ninth, and tenth in the one, rank the same in the other; rankings four and five simply change place, the only appreciable change being between the second and sixth places. The rank coefficient of correlation is .70. We thus see that money not only makes the world go round, but it makes the schools go round and thus makes intelligence go round. But this is not the explanation of the native intelligence testers; they argue, as noted, that the superior stock is the reason for the high scores as well as for the good schools; with inferior mental endowment goes poor score in the tests, and poor schools.

4. *Intelligence and Occupation*

The scores in the army tests secured by various occupational groups were also assumed without hesitation to be due to innate differences in intellectual caliber. A list of different occupational groups and their scores in the tests is given in Table 15. That the special skills of the school or the possession of the mere tools of academic learning, not to speak of education in the larger sense, affected the results would seem apparent from an inspection of the scores. Even if the farmers, laborers, miners, and teamsters had had equal schooling, they could hardly have maintained

Table 15. Army Alpha Scores Made by Different Occupational Groups (143)

45 to 49.	Farmer, laborer, general miner, and teamster.
50 to 54.	Stationary gas engine man, house hostler, horseshoer, tailor, general boilermaker, and barber.
55 to 59.	General carpenter, painter, heavy truck chauffeur, horse trainer, baker, cook, concrete or cement worker, mine drill runner, bricklayer, cobbler, caterer.
60 to 64.	General machinist, lathe hand, general blacksmith, brakeman, locomotive foreman, auto chauffeur, telegraph and telephone lineman, butcher, bridge carpenter, railroad conductor, railroad shop mechanic, locomotive engineer.
65 to 69.	Laundryman, plumber, auto repairman, general pipefitter, auto engine mechanic, auto assembler, general mechanic, tool and gauge maker, stock checker, detective and policeman, toolroom expert, ship carpenter, gunsmith, marine engineman, hand-riveter, telephone operator.
70 to 74.	Truckmaster, farrier, and veterinarian.
75 to 79.	Receiving clerk, shipping clerk, stock keeper.
80 to 84.	General electrician, telegrapher, band musician, concrete constructor foreman.
85 to 89.	Photographer.
90 to 94.	Railroad clerk.
95 to 99.	General clerk, filing clerk.
100 to 104.	Bookkeeper.
105 to 109.	Mechanical engineer.
110 to 114.	Mechanical draughtsman.
115 to 119.	Stenographer, typist, accountant, civil engineer, Y.M.C.A. secretary, medical officer.
125 and over.	Army chaplains, engineer officers.

the facility or speed in the use of pencil and paper, in the mere writing of words, to say nothing of the command of words, which the stenographers could show. These stand next to the top of the list, having spent

their lives in putting words on paper. Nor would they likely have the machine-like accuracy in numerical computations which the accountants have, who share their distinction with the stenographers, engineers, Y.M.C.A. secretaries, and medical officers, and are excelled only by the army chaplains and engineering officers. This sort of result justifies the above-quoted query of Professor Pear (96) as to whether the army tests "measured anything more than the kind of intelligence which in practical life is termed smartness, the capacity to adjust to immediate circumstances." Even the unskilled and semi-skilled laborer, the farmer and the teamster, their minds not being occupied as those of their supposedly intellectual superiors with smartly meeting the petty rounds of a high-speed office world, may have more leisure to contemplate, whether ponderously or not, on the eternal fitness or unfitness of things, and may well be distinguished in this respect from "the smart man whose aim is compliantly to live up to external demands."

5. *Speed and Intelligence*

The importance given to mere speed in the world of urban business and even of urban culture, an evaluation which the army tests so fully reflected, led to an exaltation of those who were possessed of this attitude of mind. Professor Münsterberg once proposed, I believe, a test which he called, on what grounds I have never been able to discover, a ship-captains' test. He

supposed that it would select ship captains wisely. The successful completion of the test depended on the speed and accuracy in sorting cards. One of the unfortunate possibilities, due to the method of scoring the test, was this: if one threw caution to the winds and confined attention strictly to the mere speed of sorting, with no regard for accuracy, it was possible by mere chance to make a sufficient number of right sortings that, when this number of rights was multiplied by a measure of the very high speed attained, one would secure a higher rating in the test than if one had paid more attention to accuracy. Ship captains were thus apparently regarded by the deviser of the test as men who need to decide hastily rather than carefully. Selected by the test as men of action, who set a premium on speed, they would presumably act, whether rightly or wrongly, whether action brought them into calm seas or upon the rocks. Such men would profit by a consideration of the attitude of mind described by Pear (96) as that of an Eastern potentate. So little interested was his highness in speed *per se* that, when invited to view the English Derby races, he declined on the ground that he already knew that one horse ran faster than another.

6. *Like Father, Like Son; Habit is a Second Nature*

The difficulties of disentangling the attitudes of mind, the ambitions, the interests, and the previous learning from what may, for the sake of further dis-

cussion, be called the native intelligence of individuals are nowhere better illustrated than by extending the above observational and test procedure to the second generation. It is then found that the son of the farmer is like him in intelligence as tested, the son of the laborer has the intelligence of the laborer, the sons, nay, more, the daughters of the clerks, of the business men, of the merchants, the insurance agents, and salesmen have the intelligence, no more and no less than that of their parents; and the children of the lawyers, teachers, bankers, ministers, and dentists follow suit (59, 115). This is, indeed, one of the trump cards of the inheritance determinist. What is more natural than to assume that this all follows as a result of the inheritance of fixed intellectual endowments? Our public schools offer the same educational opportunities to all: the fact that all cannot equally profit by them is due, so the argument runs, to differences in the intelligence with which individuals are born. That the attitudes of mind, the habits established before school entrance and after, the limitations of mental horizon, the fact that the child may be a chip of the old block, not because he is knocked off him, but because he has knocked around with him; that, in a word, these influences could even approximate in importance the inherited endowment seems inconceivable to the inheritance determinist.

But this has not always been the prevailing judgment in interpreting the manifestations of likeness of child to parent. In the words of Rignano (104):

Finally, we are all well aware of the powerful influence of the habits of life current in any family circle during the earliest years of a child's life — of "nurture" in the broad sense, as Galton would call it — whence there arise and develop the feelings and moral tendencies which leave an indelible trace upon the whole life as though they were "innate."[1]

In short, from these few instances adduced simply by way of illustrating our contention, we see how profound is the truth contained in the saying that habit is a "second nature."

But if, to a certain extent, we can see the most diverse affective tendencies originate by habit before our very eyes, then we may also attribute a similar mnemonic origin to all affective tendencies, since the nature of "innate" differs in no wise from that of "acquired" tendencies.[2]

Such considerations seem too remote for the inheritance determinist, and he pursues his argument with the contention that differences in stock condition differences in environment. Professor Whipple (137) takes as "a concrete illustration of these complexities" the case of

a certain boy, now 9 years old and just completing the fourth grade, who has an I.Q. in the neighborhood of 140. He is at least one grade pedagogically accelerated when his school grade is compared with his age. On looking over his school history, however, we find that he did not enter school until over 7 years of age, so that, when allowance is made for this

---

[1] This quotation from *The Psychology of Reasoning* is printed by permission the publishers, Harcourt Brace and Company, Inc.

[2] Rignano's use of "affective tendencies" is very broad, denoting those organic tendencies which appear subjectively as desires, appetites, or needs, and are "objectively translated" as "non-mechanized movements"; tendencies, then, from which not only our chief "motives" are derived, but of which the greatest variety of bodily responses or activities are the direct or indirect consequences.

late entrance, he really is two years or more pedagogically accelerated. From this point of view, his opportunities for training have been less than those of a standard child, so that his school performance is all the more remarkable. Going back a little, we discover that he learned to read spontaneously at about the age of three and one half years. At this time, he began of his own accord to pick out simple words on the typewriter. When he entered school at 7, he chanced to try the Buckingham-Ayres spelling scale and scored "eighth grade" in spelling ability. Now, how is this performance to be interpreted? Strictly speaking, for a boy with substantially no public school training to attain an eighth-grade performance means, when proper allowance is made for the lack of maturity and training, that his intrinsic ability in spelling ought to be regarded as nearer, let us say, that of the twelfth grade. In other words, the attainment of an eighth-grade score while in the second grade means really better than eighth-grade ability. But, it will be objected, this boy had been playing with a typewriter for several years, hence his early training and unusual home influences have really accounted for his performance. My answer to this objection is that the fact that the boy had these opportunities set before him is one of the *products of the superior intellectual endowment of his parents* (presumptively transmitted to the boy), and the further fact that he profited by the opportunities set before him is one of the *products of his own superior intellectual endowment*, so that, on both counts the attainment, despite the fact that it sprang from unusual environmental opportunities merely reflects and measures *superior endowment*.[1]

To this fantastic argument we shall not now attempt a further reply (although we believe it to be found in the previous discussions), but we would simply note that, while this boy was picking out words on his

[1] Reprinted from *The Scientific Monthly*, May, 1924, by permission of The Science Press, New York.

father's typewriter, another boy, who spent his time before and after entering school with his father, picking rags out of ash barrels, may eventually find himself economically, judged by the standards of dollars and cents, as well off, and believe himself as well endowed, as his classmate who "inherited" a scholastic I.Q. of 140 plus. Where such differences exist in habits, attitudes, interests, and occupations no fair comparison of relative endowment is possible.

7. *The Intelligence of Twins; Adequate Studies Needed*

"Necessitarians," said Galton, "may derive new arguments from the life history of twins." Galton himself thought, and many have since followed his lead in believing, that such studies give a decisive answer to the question of the relative potency of heredity and environment. According to his inquiries, similar twins became more alike and dissimilar twins less alike as they grew older, likenesses or differences in home and social environment having thus little or no effect on the outcome. Galton's information was secured from questionnaires. The returns were largely anecdotal in character and not convincing. Indeed, it is difficult to give credence to what appear to be trustworthy accounts when they are interspersed with such examples of naïveté and credulity as the following:

(1) Twins of twenty-three were attacked by toothache at the same time and the same tooth had to be extracted in each

case. (2) Twins, who lived two leagues apart, had the same dream at the same hour; both awoke with a violent start calling out, "I have caught the thief"; both became insane at the same time; and one drowned himself at the very spot where the other had tried unsuccessfully to do so a few hours earlier. (3) One twin, A, who happened to be in a town in Scotland, bought a set of champagne glasses, which caught his attention, as a surprise for his brother B; while, at the same time, B, being in England, bought a set of precisely the same pattern as a surprise for A (56).

The twins last mentioned doubtless had similar tastes (or thirsts). In this country at the present day, they might more likely have purchased Clicquot Club Ginger Ale or Canada Dry — evidence of the greater power of nurture over nature (in this country).

The more recent investigations of intellectual resemblances have been made by means of mental tests. The experimenters have assumed that, because of the common influences of the homes, schools, etc., environment, if it counts at all, should make older twins more alike than younger twins. This, according to their interpretation of the findings, is not the case. The actual figures are somewhat conflicting. Thorndike (124) and Merriman (89) found the older twins to be somewhat less alike, while Lauterbach (81), in the most recent and comprehensive study, finds them somewhat more alike — as far as general intelligence is concerned. If there is any merit at all in Galton's observations, these results might well depend on the proportions of similar and dissimilar twins in the groups compared. The experimenters agree that their

differences are probably due to chance. There are, however, more cogent considerations which apply to these experiments. In the first place, the assumption that all homes are alike and that they all make for intellectual resemblances is at best a questionable one. There are circumstances and conditions which may quite as well make for differences as for resemblances. Further, in the experimental studies above cited, the older twins are not the same individuals as the younger; they are different pairs, and they have not had the same home environment. The result is a statistical average of unknown quantities or qualities. An adequate study will require not only repeated measurements of the same pairs of twins from birth, but also some actual account of the circumstances of the homes, of the school, and of other environmental factors which may be pertinent to the problem. The following account is offered in support of these criticisms. It brings to the fore but one of the possible factors.

In Figure 62 the results of five annual examinations of the same pair of twins with the Stanford-Binet Intelligence Tests are shown in detail. In the first test, at the age of seven and a half, the general intellectual level was the same, a mental age of eight years and four months, or an I.Q. of 111. (See Table 16, at foot of chart.) Even in the separate tests, there is a very considerable agreement as to those which are passed or failed by the twins, as may be seen from the "psychographs" of Figure 62. In the following year, according to the tests, Harriet advanced a full two years in intellectual growth, while Helen remained stationary. Harriet has maintained her superiority during the three succeeding years in the Binet as well as in other intelligence tests, and

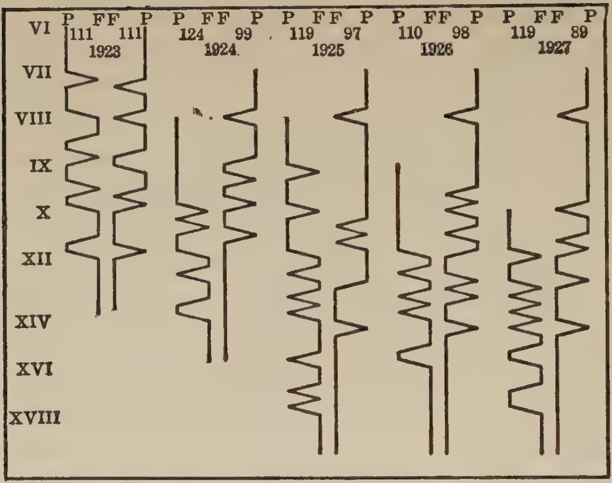


FIG. 62. STANFORD-BINET PSYCHOGRAPHS OF HARRIET AND HELEN, A PAIR OF GIRL TWINS 11 YEARS OF AGE IN 1927

P stands for pass; F for fail. The numbers indicate the year and the I.Q.

in her work in school. In the latter, she has been consistently superior to her sister. These disparities in mental development seem to be due to differences in disposition. Helen is a pretty, sweet child with a charming smile and is the immediate favorite alike of teachers and playmates as she seems also to have been of her parents. Harriet lacks these social virtues and is apparently happier in school than at home. It appears likely that she is attempting to compensate for the social success of her sister by greater intellectual effort and that her present intellectual superiority is a result of a long latent rivalry (136).

The chief advantage in the study of twins is the possibility of varying one of the complex factors at a time. If twins are alike in inheritance, then it may be possible to observe more accurately than in the case of

TABLE 16. THE RESULTS OF FIVE ANNUAL STANFORD-BINET EXAMINATIONS ON A PAIR OF TWINS

	Harriet			Helen		
	C.A.	M.A.	I.Q.	C.A.	M.A.	I.Q.
Feb., 1923........	7–6	8–4	111	7–6	8–4	111
Jan., 1924........	8–5	10–5	124	8–5	8–4	99
June, 1925........	9–10	11–8	119	9–10	9–7	99
Jan., 1926........	10–5	11–5	110	10–5	10–2	98
Dec., 1927........	11–4	13–6	119	11–4	10–1	89

other individuals the effect of differences in environment. It is now generally accepted that there is the same inheritance only in the case of the so-called identical, monozygotic (or one-egg) twins. Even in these cases, there is the possibility of differentiation between conception and birth. Finally, the means for the identification of identical twins after birth are at present entirely inadequate. Since, therefore, the factor of inheritance has not been held constant and no adequate account or control of environmental factors has been made, it is doubtful if the studies of twins have as yet offered any advantages over other experimental and statistical approaches toward the solution of the problem of the relative potency of heredity and environment.

8. *The Intelligence of Orphanage Siblings*

In the meantime, to employ again the terminology of the statistician, since there are difficulties in keeping heredity constant while varying environment, is it

possible to advance toward the solution of the problem by the opposite procedure of keeping environment constant, and noting the effects of varying heredity? A notable attempt of the latter sort has recently been made by Dr. Kate Gordon (58). Dr. Gordon found that brothers and sisters who have lived for ten years or more in orphanages have about the same degree of mental similarity as siblings who are brought up at home. It may be that family ties and the early influences of the home (before removal to the institution) persist even after ten years in the common environment of the orphanage, otherwise it is hard to see why brothers and sisters (unless they are born alike) should resemble each other more than any two boys or any two girls in the orphanage. This study may, therefore, point either to the greater influence of heredity or give added importance to the periods of gestation, infancy and early childhood according to the predilections of the reader. On the other hand, if nature is only a first habit and second and third habits, as would seem likely, differ but little from first habits, then, on this proviso, it would be futile to argue further as regards the relative influences of nature and at least early nurture.

9. *The Average Adult Mental Age and its Significance*

There is another finding which has grown out of the application of mental tests in the interpretation of which the determinist has also had his innings. It is

that the tests can determine the point of time at which intellectual development reaches its maximum, and at which intellectual growth ceases. This is said to be, *on the average*, somewhere between the ages of thirteen and eighteen years. We have been accustomed to think of the individual as developing intellectually until at least the infirmities of old age become apparent. The Biblical writer who set the span of human life at three score years and ten was himself something of a determinist, but he surely would take off his hat to the man who has been able to convince his fellows that the span of intellectual development is limited to less than one score years. Of course, the latter determinist has had a useful analogy in that, although the physical organism may live much longer, certain aspects of its development, as its height if not its weight, are also completed within this period. This decision has also been reached on the assumption that the mental tester has found a way of separating endowment from learning. He believes that the individual may continue to increase in knowledge and in breadth of experience, but it appears to him that, when the average adult is faced with numerous situations as new to him as to the fifteen-year-old, in which he has not had special training and experience (and he cannot have had extended acquaintance in all the possible specializations of human knowledge and experience), the general level of his performance is no better than that of the fourteen- or fifteen-year-old.

The average mental age of adults was first set at about sixteen years on the basis of an examination by Terman of a group of high-school pupils, who were over sixteen years of age, and of a number of business men of varying ages. The army tests set the age at which intellectual development ceases at about thirteen years for the average American. The injustice of the latter deduction has already been commented on.

The fact that the age at which children begin to leave school is also found to be the time at which their mental growth ceases, *on the average*, has apparently been regarded as a mere coincidence. But is it a coincidence, or does the finding indicate that the tests in question measure chiefly the habits and interests ordinarily acquired in school, which many adults may either have never learned well or have forgotten? In their place, other interests and habits may have been acquired, in other environments than the school, which are quite as significant for any adequate estimate of intelligence, but which the tests in question do not adequately measure. That children of twelve and thirteen in school do as well on the average as the adults in the army did in these tests may, then, as above noted, be due in part to the skills which children have acquired from recent practice in the use of paper and pencil, in the carrying-out of directions, in writing, figuring, etc. — skills which many of the adults may have lost.

One possible misconception in speaking of the average mental age of adults should be mentioned. It must be remembered that this is an average, and that all of our findings would lead us to expect as great a range of variability on the one side of this average as on the other. Individuals of adult years are commonly known who, without the direct incidence of accident or disease, can only pass the mental tests of two-year-olds, one-year-olds, or less. Although there is some difference of finding and opinion, it is probable that they do not require the full period of years to attain to this humble intellectual elevation. There is undoubtedly some intellectual growth over a considerable period of time, but arrest presumably sets in somewhat earlier than in the case of the average. At the other extreme, we should expect to find individuals as much superior to the average as the one-year-olds are inferior to it, and who may require a longer time, say, as many as thirty years, to gain their respective eminences.

We may also note that one other possible reason why the average is found at this early period is that after children leave school the various specializations of learning become so great that the tests are no longer able to take account of them, as they were when they tested the relative attainments (as in school) of what every one was attempting to learn. The failure to measure further intellectual development may thus be laid to the limitations of the test methods.

But, taking the tests for what they are worth, an attempt of the writer (43) to determine the age at which the average child no longer improves in his score in the tests may illustrate the problems involved. The difficulty with previous studies has been that, because of the elimination of pupils from school beginning with the age of fourteen, it has not been possible to test representative groups of school-children after that age. The Massachusetts laws require that children who leave the regular schools between the ages of fourteen and sixteen years must attend continuation schools. If we are to secure an unselected group on which to base our average, these children must be included with those in the regular schools. This investigation has supplied this necessary information in regard to practically all of the fourteen- and fifteen-year-olds in several Massachusetts cities. In one typical city, there are to be found 454 fourteen-year-olds and 457 fifteen-year-olds. The mean scores of the fifteen-year-olds in the tests show no appreciable advance over the fourteen-year-olds. The scores and mental age equivalents are shown in the last two columns of Table 17.

If one considers those in the regular schools alone, as has hitherto been done, the fifteen-year-olds advance over the fourteen-year-olds (columns 2 and 1). This is the result, as pointed out, of the elimination of the continuation-school group. There are 112 of the fourteen-year-olds, and 208 of the fifteen-year-olds in

the continuation school. Their average scores are respectively thirty-eight and forty points less than those in the regular schools. In terms of mental age, they average, respectively, two years and seven months, and two years and nine months lower than the pupils in the regular schools.

In Figure 63, the distributions of the scores of all the fourteen-year-olds and of all the fifteen-year-olds are shown by the heavy lines. The shaded areas show the scores of the continuation-school groups. The similarity in the form of the two distributions is striking. The only children of these ages in the cities who are not included were those in the private and parochial schools. The records returned by these schools showed that there were 126 of these children. The fourteen-and fifteen-year-olds are not separated in

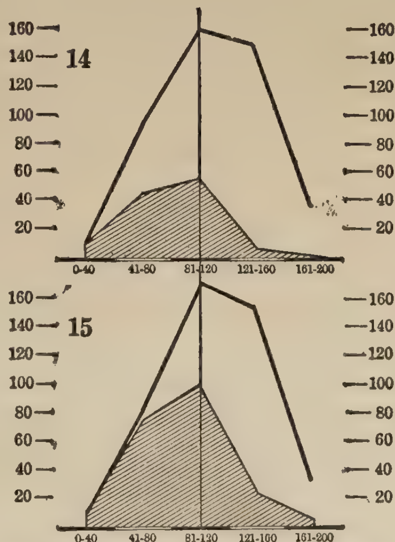


FIG. 63. DISTRIBUTION OF INTELLIGENCE TEST SCORES OF ALL THE FOURTEEN- AND FIFTEEN-YEAR-OLDS IN ONE MASSACHUSETTS CITY (Series II, General Examination 4 and 5) (Dearborn)

these returns, but they must be approximately equal in number judging from equality in the numbers of these ages in the public schools. Possibly these children might somewhat raise or lower the average scores

TABLE 17. MEAN SCORES AND MENTAL AGES OF PUPILS FOURTEEN AND FIFTEEN YEARS OLD

	In Regular School		In Continuation School		In All Schools	
	(1) Age 14	(2) Age 15	(3) Age 14	(4) Age 15	(5) Age 14	(6) Age 15
Scores	119	129	81	89	110	111
Mental ages	14–5	15–1	11–10	12–4	13–9	13–10
Number of pupils	342	249	112	208	454	457

of both groups; but probably they would not affect the similarity of the groups nor the equality of their averages because, aside from the small number of cases involved, it is not likely that the sort of fourteen-year-old children going to private and parochial schools differs materially from the sort of fifteen-year-olds going to these schools.

The average mental ages of these two total groups in terms of the standards of the tests are thirteen years, nine months, and thirteen years, ten months, respectively. The average mental ages of some 3400 fourteen- and fifteen-year-olds in the cities so far studied are practically the same; namely, between thirteen years, eight months, and thirteen years, ten months. If these cities are typical of the country at large, we should need to assume that the average

adult age, as far as these tests show it, is between thirteen and a half and fourteen. For various reasons, chiefly because of the proportion of children of foreign-born parents, we do not believe these communities, or at least the results of the tests, are quite typical of the average population of the country — hard as that is to estimate. The discussion of other material secured in the investigation, which we need not here review, has pointed to an average nearer fourteen, but for the purposes of the present argument, we shall assume the average adult age to be somewhat higher; namely, fourteen and a half.

If we make this assumption and change our scores into intelligence quotients, we have two ways of calculating the quotients. We may calculate them in the usual way, by dividing the mental age equivalents of the scores by the chronological ages of the pupils, or the fourteen- and fifteen-year-old scores or score equivalents may be divided by no chronological age higher than fourteen and a half.

The results in the case of the fourteen-year-olds are (omitting decimal points) practically the same by either method (see Table 18). But if we use the usual method for the fifteen-year-olds, those in the regular schools have a slightly lower median I.Q. (101 instead of 102) than the fourteen-year-olds, although we know that, because of the removal of pupils to the continuation school, they must average higher than the fourteen-year-olds. The total group of fifteen-

year-olds averages but 90 I.Q. as compared with 96 for the fourteen-year-olds, whereas the groups should average the same. Calculating the I.Q.'s on the basis of fourteen and a half as the average adult age, the findings are such as the facts established by the scores would indicate; namely, first a gain in the average I.Q.'s of the fifteen-year-olds in the regular schools of five points, secondly, about the same average I.Q.'s, 96 and 95, for the total groups of fourteen- and fifteen-year-olds. The different results by the two methods are graphically shown in the chart of Figure 64. The broken lines in the figure show the results by the usual method, the continuous lines by the proposed method.

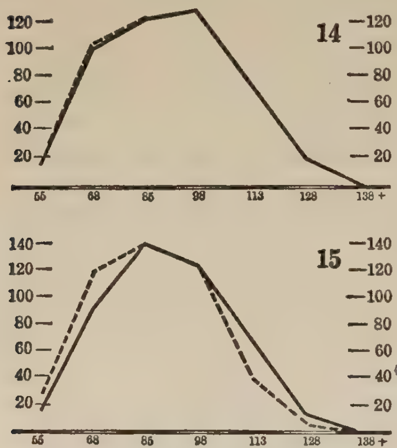


FIG. 64. I.Q. DISTRIBUTIONS FOR FOURTEEN- AND FIFTEEN-YEAR-OLD PUPILS IN ONE MASSACHUSETTS CITY (Series II, General Examination 4 and 5) (Dearborn)

Solid lines are the result of taking the adult age as 14 years and 6 months. The broken lines are the result of taking the adult age as 16 years.

If we apply the usual and proposed methods of calculating the intelligence quotients to the age and

TABLE 18. MEDIAN INTELLIGENCE QUOTIENTS OF FOURTEEN- AND FIFTEEN-YEAR-OLD PUPILS

	In Regular Schools		In Continuation Schools		In All Schools	
	Median	Quartile Deviation	Median	Quartile Deviation	Median	Quartile Deviation
Fourteen.........	102	12	83	6	96	13
Fifteen						
(a) Average Adult Age = 16.........	101	10	80	7	90	12
(b) Average Adult Age = 14½.......	106	10	85	8	95	13

Median Score = 85; −Q = 22; + Q = 22
Median I.Q. = 110.5; − Q = 13.8; + Q = 13.8

grade distributions of a number of communities, further support for the assumption of an average adult mental age in the neighborhood of fourteen and a half is discovered. The results are shown in Table 19.

The average I.Q.'s of age groups up to thirteen inclusive and of grades V–VII inclusive are approximately 100. The lower medians in grades II, III, and IV are due to retarded pupils. On the usual basis of calculation, the I.Q.'s of the fourteen-year-olds average the same as the fifteen-year-olds, namely, about 101. On the proposed basis, the I.Q.'s of the fifteen-year-olds average 107, sixteen-year-olds nearly 112, and the seventeen-year-olds 115. The median I.Q.'s of the high-school pupils advance, by the usual method of calculation, but little over the I.Q. of the

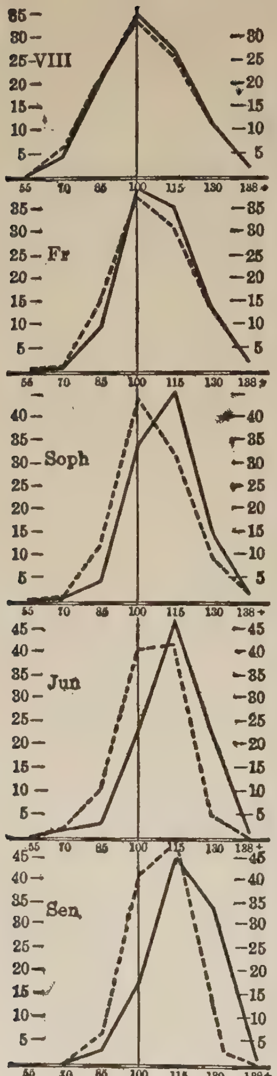


FIG. 65. I.Q. DISTRIBUTION BY GRADE IN THREE MASSACHUSETTS TOWNS (Series II, revised) (Dearborn)
Full-line curves result from taking adult age as 14 years and 6 months: broken lines show results from taking adult age as 16 years

eighth grade, 104 for the eighth grade, and 108 for high-school seniors. By the proposed method the high-school seniors average about fifteen points higher in their intelligence quotients than the pupils in the eighth grade. These comparisons are best shown by the charts of Figures 65 and 66, in which the dotted lines show the distributions of I.Q.'s by the usual method and the continuous lines the distributions by the proposed method.

By studies which were made at the time of this investigation, it was proved that those who had left school at age fourteen were inferior in the abilities tested to those who remained in school. It is reasonable, then, to ex-

TABLE 19. MEDIAN I.Q.'S AND VARIABILITIES BY AGE AND GRADE IN THREE MASSACHUSETTS TOWNS

Grade	Number of Cases	Basis of Calculation				Age	Number of Cases	Basis of Calculation			
		Usual		Proposed				Usual		Proposed	
		Median	Q	Median	Q			Median	Q	Median	Q
II...	380	97.9	8			7	235	101.7	7		
III...	401	96.4	10			8	388	101.4	10		
IV...	409	97.6	11			9	417	99.0	10		
V...	407	100.8	10			10	377	100.5	12		
VI...	387	101.3	11	101.3	11	11	387	102.9	11		
VII...	416	99.3	13	99.4	13	12	385	100.2	13		
VIII...	325	104.2	12	104.8	11	13	397	100.5	14		
						14	332	101.5	11	101.8	12
IX..	286	106.5	10	108.1	9	15	257	101.6	9	107.6	10
X...	265	105.6	8	110.7	7	16	223	102.0	8	111.7	9
XI...	203	107.0	7	114.5	8	17	101	105.1	8	115.0	8
XII...	131	108.1	7	119.7	8	18	37	103.8		114.3	

pect that the I.Q.'s of the fifteen-year-olds who are comparable, after the lapse of a year, to the fourteen-year-olds who remained in school — should be somewhat higher than the I.Q.'s of the unselected fourteen-year-olds. And so they are by the proposed method, as is shown by the heavy lines (Figure 66); whereas by the older method of figuring on the assumption of sixteen years as the average adult age, the fifteen-year-olds, whom we know to be a selected group, would appear no better than the fourteen-year-olds. The same arguments apply to the comparison of sixteen-year-olds by the old and new methods of calculating the intelligence quotients.

The same consideration applies to the charts of

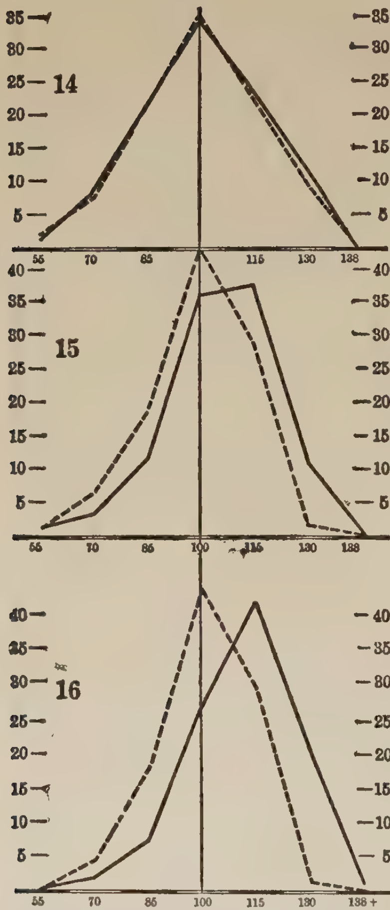


Fig. 66. I.Q. Distribution by Ages in Three Massachusetts Towns (Series II, revised) (Dearborn)

Full-line curves result from taking adult age as 14 years and 6 months: broken lines show results from taking adult age as 16 years.

Figure 65. On the assumption of an average adult mental age of sixteen, the pupils in the last three years of high school would appear but little brighter than those of the eighth grade, but, since we know that those who left school at the end of the eighth grade were not as intelligent (as far as the tests go) as those who remained in school, we must, in order to have our results square with these findings, calculate the intelligence quotients of those over fourteen years old on the assumption of an

average adult mental age of fourteen and a half. When this is done, the intelligence quotients of the high-school pupils, as shown in the heavy lines, agree with the established facts.[1]

Professor Whipple, in a study of all the pupils in a Michigan city (137), has reached the same conclusions as to the average adult age.

I made a special attempt recently to secure satisfactory data on the National Intelligence tests for the ages beyond

[1] Professor Freeman, in a book which comes to hand as this manuscript is being prepared for the press, writes in criticism of the above experiment that the tests used (the first edition of my own group tests) may be too easy for pupils beyond the age of fourteen so that the abilities of older pupils are not recognized. (*Mental Tests*, Boston, Houghton Mifflin Co., 1926, p. 362.) The point is not, I believe, well taken. These tests show increments *on the part of those who remain in school* up to the age of eighteen (just as do the Otis and other tests which Professor Freeman believes may show that growth continues up to this age), and college students do better in the tests than high-school pupils, but neither high-school nor college students are fair samples of the population. The only merit of my experiment is the attempt to secure a fair sample of the population at these ages by including both those who are in and those who are out of school.

Even in the revised form of these tests, which is not as difficult as the original form, among 656 fifteen- and sixteen-year-old pupils, who were in the regular schools of representative New England communities, there was not one who had a perfect score and only twenty had scores of 150 or over, the maximum score being 171. Among the records of 100 seventeen-year-olds, there was no perfect score, and only three had scores over 150. The median scores of successive classes of Harvard and Radcliffe undergraduates are in the neighborhood of 155, with no perfect scores. On the original form of the tests, on which, to repeat, the above deductions of the text were based, only one perfect score has been reported. This score was made by a graduate student, an engineer and expert stenographer, and a man, in general, of extraordinary proficiency in things which can be done with paper and pencil.

the elementary-school period. In one Michigan city, it was possible to test every 14-year-old and 15-year-old child. The average scores for 14 and 15 years were 139 and 142, respectively, i.e., the performances in these two ages were practically indistinguishable. The annual increments of scores for the same test, beginning at the step from 8 to 9 years, are 15, 15, 17, 16, 15, 9, 3. This seems to confirm very definitely the idea that, on the average, at about $14\frac{1}{2}$ years, maturity ceases to be a factor at least so far as these tests are concerned.[1]

Studies bearing on this problem, made by Brooks (25) and Thorndike (127) by means of repeated tests of the same pupils, show no evidence of the cessation of growth of the pupils up to the ages of fifteen or sixteen, or up to at least the twelfth grade of school. Although the method followed, repeated measurements of the same pupils, is safer than that above described, the findings are limited to pupils who stay in school, and therefore may be interpreted as simply showing the effects of further schooling on the abilities which the tests measure.

Although the writer has himself made one of the investigations and has drawn certain conclusions from it about a possible average adult mental age in the neighborhood of fourteen and a half, he would oppose, after subsequent consideration of the problem, no particular objections if he were met with some such criticism as the following: You have been to a lot of pains to discover a rather obvious thing. By the use

[1] Reprinted from *The Scientific Monthly*, May, 1924, by permission of The Science Press, New York.

of certain tests which you now know to be largely scholastic in nature, and to correlate well with school learning, you have shown that so long as pupils stay in school you can measure their progress in what you are pleased to call general intelligence and which might equally well be called general school learning, but when they begin to leave school in considerable numbers, and have become interested chiefly in non-scholastic jobs and occupations, you suddenly discover that as a group they are no longer improving in school learning. They may be improving their minds by learning something else, or they may be stultifying them in some occupation which requires the acquisition of no new skills, but only the automatic employment of those they have, but, whether there is, or is not, further intellectual development, your tests are not competent to tell. They can only tell whether the individuals have learned any more of the sort of things that are taught in school, or have acquired further experiences of this character. And finally, to be frank with you, you have no business to go about talking of tests of general intelligence, because your tests do not discover all the intelligence of all the pupils, even when they are in school, and of what intelligence they may employ out of school, your tests take even less account.

Of course the writer would prefer, if such criticisms are to be made, that they should be directed at Professor Whipple whose comparable experiment and

deductions have just been cited, or at Professor Godfrey Thomson, who, according to newspaper reports of a book just published, agrees with the earlier judgment of Professor Terman in settling on age sixteen as the time when the mind is at its best.[1] Ballard (11), Burt (27), and Hart (60) have, among others, also attempted to deduce experimental evidence in regard to the limits of the growth of intelligence, and are thus equally subject to these criticisms, but certainly no more so than the general run of mental testers, who, ~~with or~~ without attempting experimental

[1] A news item in the *Boston Transcript* of March 4, 1925: The book (Thomson: *Instinct, Intelligence and Character*, Longmans, Green & Co.) shows Professor Thomson to be, as might well have been anticipated, much more cautious, as to wit in the following statement: "If I confess myself as by no means convinced that the limit of growth of intelligence occurs as early as sixteen years, I must confess also that the evidence on the whole points that way." Doubts in regard to the determination of an age limit for the growth of intelligence, similar to those expressed by the writer, also appear in the following paragraph: "Another possible criticism of the sixteen-year limit of intelligence is that perhaps there is something in the tests which creates it, in this way. The commonest form of test is one which uses material which, it is supposed, is the common property of every one, the possession of which does not depend upon schooling, or only upon such schooling as inevitably comes to every child. Now towards the age of fourteen it becomes increasingly difficult to make questions which are confined to such material and are hard enough to extend the cleverer children. They could do more difficult thinking, perhaps, but examples of such are always placed in some province of reasoning where particular knowledge is also necessary, such as mathematics, economics, or engineering. Perhaps the curve turns at sixteen just because it is impossible to make tests which both are hard enough to extend the older cleverer subjects and also are confined to common knowledge for their materials." (Reprinted by permission of the publishers.)

& condition × since page

approaches, have assumed that mental growth ceases in the teens.[1]

10. *Drawn Battles: The Natural Limitations of the Memory*

This attempt to differentiate the native endowment from subsequent acquisitions is exactly paralleled by the similarly deterministic idea of William James in regard to the natural limitations of the memory. When battles are drawn, they may be refought by succeeding generations. James (73) [2] wrote:

> It will now appear clear that *all improvement of the memory lies in the line of* ELABORATING THE ASSOCIATES of each of the several things to be remembered. *No amount of culture would seem capable of modifying a man's* GENERAL

[1] Thurstone in his recent conclusion, from an examination of Burt's data, that the growth of test intelligence continues beyond the age of fourteen and may continue into the early twenties ("A Method of Scaling Tests," *Journal of Educational Psychology*, vol. XVI, no. 7, October, 1925), would seem to the writer to have failed to take account of the fact that the data used dealt only with children who were continuing in school. Burt himself recognized the technical limitations of the Binet-test data. He writes in a "Note on the Average Upper Limit for the Development of Intelligence" as follows: "My present conclusion is based, not upon experiments with the Binet-Simon scale, but upon supplementary tests of intelligence, such as those above described. My data are incomplete and provisional. They have been obtained, not only from students in Universities and Training Colleges, who are, of course, of super-normal grade, but also from adults in various spheres of life, who from their educational history may be regarded as median or average specimens of the ordinary elementary-school class. Inquiries begun in the new continuation schools, whereby the same individuals will be tested and retested year after year, may, I hope, eventually return a conclusive reply."

[2] *The Principles of Psychology*, vol. I. New York, Holt, 1902.

retentiveness. This is a physiological quality given once for all with his organization, and which he can never hope to change. . . . It is, in fact, commonly thought that certain exercises, systematically repeated, will strengthen, not only a man's remembrance of the particular facts used in the exercises, but his faculty for remembering facts at large. And a plausible case is always made out by saying that practice in learning words by heart makes it easier to learn new words in the same way. If this be true, then what I have just said is false, and the whole doctrine of memory as due to "paths" must be revised. But I am disposed to think the alleged fact untrue. I have carefully questioned several mature actors on the point, and all have denied that the practice of learning parts has made any such difference as is alleged. What it has done for them is to improve their power of *studying* a part systematically. Their mind is now full of precedents in the way of intonation, emphasis, gesticulation; the new words awaken distinct suggestions and decisions; are caught up, in fact, into a pre-existing net-work, like the merchant's prices, or the athlete's store of "records," and are recollected easier, although the mere native tenacity is not a whit improved, and is usually, in fact, impaired by age. It is a case of better remembering by better *thinking* (73).

Thus the non-improvableness of native retentiveness seems to be argued by accounting for such improvement as appears in memory by an improvement in some other "faculty" of the mind. Whatever the merits of the argument in the case of memory, this chasing of the devil of improvableness around the bushes (or faculties) of the mind is hardly possible in the case of intelligence, since intelligence is the resultant of the operation of all the faculties of the mind. Here, as elsewhere, it would seem best to recognize the existence of a "zone" within which it is not pos-

sible to separate innate from acquired characters. Nature sets certain general limits, but for each individual, there is a "margin of safety" or a range of accomplishment which is a function of the environment, and the extent of which can only be ascertained by individual effort under the most favorable conditions.

The escape of experimental studies of memory from this inhibiting notion is described in the following statement of a capable experimentalist in the field of memory:

> In the older psychology, the laws of association alone accounted for recall. To the a priori deductions of these laws was added James's dictum that native retentiveness in memory is unchangeable. This might seem, and undoubtedly has seemed to many, to hold out but meager hopes that anything should be discovered that would improve learning and memory. We have quite outgrown this view. Problems concerning economic methods of learning are increasing rapidly, and they are leaving the laws of association and the question as to the permanency of native retentiveness out of consideration (78).

11. *Intelligence as an Improvable Character*

Similarly, the clinical psychologist is disregarding the theoretical analysis of native intelligence as an unimprovable character, and is setting about to see what he can do about the matter. And he is showing that, when he can make sufficiently radical changes in conditions, he can alter mental ages and intelligence quotients. Each case is an individual problem whose potentialities can only be determined by trial, and,

presumably, the earlier the trial is made in the life history of the individual, the less may be the limitations imposed either by nature or by habit. Thus the observations of Dr. Helen Woolley of a marked increase in the intelligence quotients of young children, after six months or more of attendance at an excellent nursery school in Detroit (whereas there was no change on the part of children on the waiting list of the school), may be interpreted (1) as a temporary change due to the unusually early acquisition of a little school knowledge (and behavior), (2) as an acceleration of the normal rate of maturity which may also be temporary, or (3) as evidence that nature itself had profited a little by the experiment! Professor Whipple believes the explanation is to be found only in the first two factors and adds: "Further retests, after these children have settled down in the earlier grades of the primary school, will, I venture to predict, confirm this interpretation." It may well be that, just because these children ordinarily do settle down in the early grades of the primary school, and because the ordinary homes and schools have not the wisdom nor competence to carry on the experiment as it was begun, Professor Whipple's prophecy will come true.

Professor Root, after citing instances of improvement in mentality following betterments in living conditions in the case of children removed from "abject conditions" into superior homes and into excellent institutions, remarks:

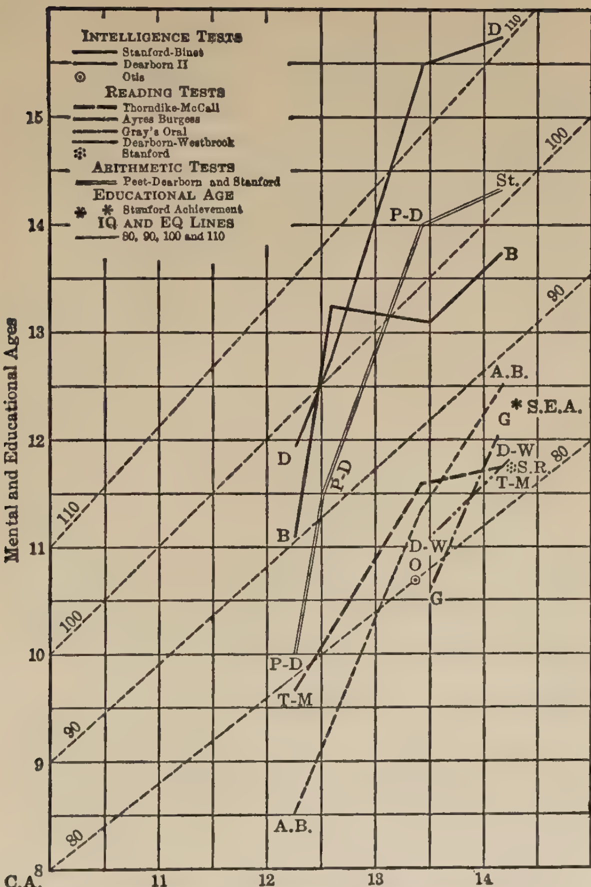


Fig. 67. Mental and Educational Age Scores of a Pupil with a Special Disability in Reading

There is nothing in the cases just cited which does violence to any of the known facts concerning the origin or composition of the data from which the I.Q. is derived. Such data depend, in the by and large, upon all of the factors lying back of complex human behavior remaining relatively constant; in the above cases we have introduced marked change, tearing the child away from family habits, mores, and influences that under ordinary laissez-faire conditions might have required three or four generations to effect. One may thoroughly believe in the constancy of the I.Q. and with perfect consistency refuse to accept statistical trends if there is evidence of marked departure between the first and second test in any one of the factors making up the composite nature of behavior. Any other procedure would be to have the statistical tail wag the causal dog (105).

Quite as significant is the general improvement which may result from overcoming a special disability of the mind. Professor Root cites an example in the article just quoted, and others have been given in the preceding discussions. Figure 67 provides a further graphic illustration of such a change. (See also Table 20.)

Charles, a boy of twelve, was brought to the clinic for examination by his father who wished to know whether his son was stupid, or lazy, or both. Although the boy had been for six years in what was considered to be a good private school and had no end of supplementary tutoring, he was at least two years retarded scholastically, and especially deficient in reading and spelling. It was soon established that Charles was industrious enough, but that his industry profited him so little that he had become, if not mentally stale, at least complacently resigned to his lot — a plain plodder. In the Binet intelligence test he appeared to be about a year retarded having a mental age of eleven; his ability in reading was hardly better than that of the average boy of nine. The

TABLE 20. INTELLIGENCE AND ACHIEVEMENT AGES AND QUOTIENTS MADE BY A PUPIL WITH A SPECIAL READING DISABILITY

Age	Mental Age		Reading Age				Arith. Prob.
	Binet	Dearborn	Thorndike McCall	Ayres Burgess	Dearborn Westbrook	Gray	Peet Dearborn
12–3	11–1	11–11	9–8	8–6			10–0
12–6 to 12–7	13–3	12–9					11–6
13–5 to 13–6	13–1	15–6	11–7	11–4	11–1	10–7	14–0
14–2 to 14–3	13–9	15–9	11–9	12–6	11–10	12–1	14–4 (Stanford)
	Intelligence Quotients		Reading Quotients				Arith. Prob. Quotients
12–3	90	97	79	69			82
12–6 to 12–7	105	101					92
13–5 to 13–6	97	116	86	84	82		104
14–2 to 14–3	97	111	83	88	83		101

Otis (self administrating) C.A. 13–5, M.A. 10–9, I.Q. 80.
Stanford achievement C.A. 14–3, E.A. 12–4, E.Q. 87.
Stanford reading C.A. 14–3, R.A. 11–10, R.Q. 83.

figures of Table 20 and the lines of the chart show the results of two years of effort to better conditions. The boy's intellectual and scholastic advancement is handicapped by what amounts to a special disability in learning to read, but with every step of progress in reading, there is a corresponding gain in the more general intellectual development. When he finally overcomes the disability in reading, as he can under more favorable conditions than it has been possible as yet to bring about — except for the short period below mentioned — it is confidently expected that he will equal in general intellectual ability the average of his classmates (the I.Q. line of 110) with whom he is now waging an unequal

battle. This prophecy is supported by his present accomplishment in an intelligence test (my own) which is less affected than the Binet test by linguistic abilities. During nine weeks of the period under discussion, Charles was under the expert tutelage of an inspiring teacher and companion of boys. He accomplished more in that time than in any year of previous school work, and might well in a year more of such instruction not only have reached the immediate goal of this experiment a scholastic and intellectual "Q" of 110, but have possessed himself of a well trained mind.

The search for opportunities to improve intelligence, which the above-cited experiments illustrate in however so small a way, rather than complacent acceptance of statistical trends, might well, "if instituted on a larger scale, appreciably raise the median performance or change the intelligence rank order of certain classes of cases" (105).

12. *The Policy of the School and of Society*

Such should be the policy of the schools and of society. A college president in his inaugural address has recently "speculated" on the effects of mental tests on the problems of democracy. He anticipates that they will result in a caste system as rigid as that of India, but on a rational and just basis: Those of high intelligence will be directed into lines of occupation which call for leadership; those of low intelligence into work of the most routine character (35). The capable administrators, who will doubtless be on hand to carry out this scheme, will find it much easier to manage if they can count on the constancy

of the I.Q., assume that the sons of the leaders will be born with leadership, etc., and be assured of but few exceptions to disturb the simplicity of their rulings. They of all men can hardly be expected to stir up trouble for themselves.[1]

Democracy implies, in the words of a thoughtful educational philosopher, "the right of the individual to share in the spiritual life of the race." If the mental tester and the schools are making for an intellectual aristocracy, it is because they are partial in their views of what constitutes intellectual life. It must needs be recognized that knowledge worth while is not confined to the verbal and numerical abstractions out of which have been built both the tests and the ladder-like progression of the schools from the kindergarten to the university, and that the pursuit of other knowledge, if it can be pursued at all in the schools, too often leads into blind alleys. The effect of these shortcomings on the intellectual life of various groups has been pointed out in the preceding chapters. These blind alleys should be replaced by highways into the life of society. When they are once opened, they will be as well traveled as the pres-

[1] The conclusion of a recent investigation by one of my students (115) is that, while there is no doubt but that those of the most favored classes have intellectually superior children (to which I add "under present conditions and as judged by present standards"), it is also true, because of the larger numbers of other classes, that seventy-five per cent of the total number of superior children come from less favored classes. This can only mean more trouble for the world managers!

ent academic road. Thus, through the providing of a greater variety of ways for the development of intellectual interests and the recognition of their essential equality in advancing the welfare of the individual and of society, each individual may share, as in a true democracy, in the spiritual life of the race.

BIBLIOGRAPHY

1. Adams, John: "Educational Implications of the I.Q.," *Australian Journal of Psychology and Philosophy*, vol. I, 1923.
2. Alexander, Herbert B.: "A Comparison of the Ranks of American States in Army Alpha and in Social Economic Status," *School and Society*, vol. XVI, Sept. 30, 1922.
3. Allen, Richard D.: "Educational and Vocational Guidance in the Providence Public Schools," *National Vocational Guidance Association Bulletin* II, no. 4, Jan., 1924. See also, Providence Public School Bulletin, vols. I and II.
4. Anderson, Victor V.: "A Study of the Careers of 321 Feeble-Minded Persons who have been in the Special Classes and are now out in the Community," American Association for the Study of the Feeble-Minded, *Proceedings*, 46th Annual Session, 1922.
5. Arlitt, Ada Hart: "The Relation of Intelligence to Age in Negro Children." *Proceedings*, 30th Annual Meeting of American Psychological Association, vol. XIV, 1921.
6. Arlitt, Ada Hart, and Hall, Margaret: "Intelligence Tests vs. Entrance Examinations as Measures of Predicting Success in College," *Journal of Applied Psychology*, vol. VII, p. 330, 1923.
7. Ayres, Leonard P.: *Laggards in our Schools: A Study of Retardation and Elimination in City School Systems*. Charities Publishing Committee, 1909.
8. Bagley, William C.: "Educational Determinism," *School and Society*, vol. 15, pp. 373–84, 1922.
9. Baldwin, Bird T., and Stecher, L. T.: "Mental Growth Curves of Normal and Superior Children," *University*

of Iowa Studies in Child Welfare, vol. II, no. 1, January, 1922.

10. Ballard, P. B.: *Mental Tests.* London, Hodder and Stoughton, 1920.
11. Ballard, P. B.: "The Limit of the Growth of Intelligence," *British Journal of Psychology*, vol. 12, pp. 125–41, 1921–22.
12. Battey, P. B.: "Psychiatric Survey of the Connecticut State Prison," *Monthly Record Press*, Hartford, 1920.
13. Beatley, Bancroft: "The Relative Standing of Pupils in Secondary School in Comprehensive Examinations, and in College," *The School Review*, vol. XXX, no. 2, February, 1922.
14. Berman, Louis: *The Glands Regulating Personality.* Macmillan, 1921.
15. Bernstein, Charles: "Colony and Extra-Institutional Care of the Feeble-Minded," *Mental Hygiene*, vol. 4, pp. 1–28, January, 1920; "Colony and Parole Care for Dependents and Defectives," *Mental Hygiene*, vol. 7, pp. 449–71, July, 1923.
16. Berry, Charles Scott: "Classification by Tests of 10,000 First-Grade Pupils," *Journal of Educational Research*, October, 1922.
17. Berry, Charles Scott: "The Case for the Mentally Retarded," *Mental Hygiene*, vol. IX, pp. 725–34, October, 1925.
18. Binet, A., and Simon: "Méthodes nouvelles pour le diagnostic du niveau intellectuel des anormaux," *Année Psychologique*, vol. XI, 1905.
19. Binet, A.: *Les idées modernes sur les enfants.* E. Flammarion, Paris, 1909.
20. Bliss, Don C.: "High School Failures," *Educational Administration and Supervision*, vol. III, pp. 125–38, 1917.
21. Boaz, Franz: "Growth and Development, Bodily and Mental, as Determined by Heredity and Social Environment," *The Child, the Clinic, and the Court.* New York, New Republic, Inc., 1925.
22. Bok, S. T.: "Stimulogeneous Fibrillation as a Cause of

the Structure of the Nervous System," *Psychiatrische en Neurologische Bladen*, vol. XIX, pp. 393–408, 1915.

23. Brigham, Carl C.: *A Study of American Intelligence.* Princeton, Princeton University Press, 1923.
24. Brigham, Carl C.: "Correlation of the Examinations of the College Entrance Examination Board with College Standing," *Journal of Engineering Education*, New Series, vol. XV, no. 9, May, 1925.
25. Brooks, Fowler D.: *Changes in Mental Traits with Age Determined by Annual Retests.* New York, Teachers College, Columbia University, 1921.
26. Burt, Cyril: *The Distribution and Relations of Educational Abilities.* London, King and Son.
27. Burt, Cyril: *Mental and Scholastic Tests.* London, King and Son, 1921.
28. Burt, Cyril: "Causes and Treatment of Juvenile Delinquency," *Psyche*, vol. II, no. 3, January, 1922.
29. Burt, Cyril: "Delinquency and Mental Defect," *British Journal Medical Psychology*, vol. III, pp. 168–78, 1925.
30. Carter, Ralph E.: "Correlation of Elementary and High Schools," *Elementary School Teacher*, vol. 12, pp. 109–18, 1911.
31. Child, C. M.: *The Origin and Development of the Nervous System.* Chicago, University of Chicago Press, 1921.
32. Clement, J. A.: *Standardization of the Schools of Kansas.* Chicago, University of Chicago Press, 1912.
33. Cobb, M. V.: "The Limits Set to Educational Achievement by Limited Intelligence," *Journal of Educational Psychology*, vol. XIII, November, 1922.
34. Cobb, M. V., and others: "The Special Opportunity Class for Gifted Children, Public School 165, Manhattan," *Ungraded*, vol. VIII, no. 6, p. 121, March, 1923.
35. Cutten, G. B.: "The Reconstruction of Democracy," *School and Society*, vol. XVI, pp. 480–81, 1922.
36. Dearborn, Walter F.: *The Relative Standing of Pupils in the High School and in the University*, Bulletin of the University of Wisconsin, no. 312, High School Series, no. 6, Madison, 1909.

37. Dearborn, Walter F.: *School and University Grades.* Bulletin of the University of Wisconsin, no. 368, High School Series, no. 9, Madison, 1910.
38. Dearborn, Walter F.: *Formen des Infantilismus mit Berücksichtigung ihre klinischen Unterscheidung, Sonderabruck aus der Zeitsch. f. d. Erforschung u. Behandlung des jugendlichen Schwachsinns.* Jena, Gustav Fischer, 1912.
39. Dearborn, Walter F.: "The Practical Results of Recent Studies in Educational Statistics," *Proceedings*, Harvard Teachers' Association, pp. 19–28, March, 1913.
40. Dearborn, Walter F.: *The Dearborn Group Tests of Intelligence*, Revised Edition, Series I, General Examination A and B. Philadelphia, Lippincott, 1922.
41. Dearborn, Walter F.: *The Dearborn Group Tests of Intelligence*, Series II, General Examinations 4 and 5 (1920); Series II, Revised Edition, General Examinations C and D. Philadelphia, Lippincott, 1922.
42. Dearborn, Walter F.: "Intelligence and Its Measurement; A Symposium," *Journal of Educational Psychology*, vol. XII, no. 4, pp. 210–11, April, 1921.
43. Dearborn, Walter F.: "The Intelligence Quotients of Adults and Related Problems," *Journal of Educational Research*, vol. VI, pp. 307–25, November, 1922.
44. Dearborn, Walter F.: *The Child, His Nature and His Needs*, Chapter III, "The Development of the Intellect in Childhood and Youth." The Children's Foundation, Valparaiso, Indiana, 1924.
45. Dearborn, Walter F.: "Intelligent Parenthood," *Proceedings*, Mid-West Conference on Parent Education. Chicago, The University of Chicago Press, March, 1926.
46. Dearborn, Walter F., and Inglis, Alexander: "Psychological and Educational Tests in the Public Schools of Winchester, Virginia," *University of Virginia Record*, vol. VI, no. 6, January, 1922.
47. Dearborn, Walter F., Shaw, E. A., and Lincoln, E. A.: *A Series of Form Board and Performance Tests of Intelligence*, Harvard Monographs in Education, Series I,

vol. 1, no. 4. Cambridge, Harvard University Press, 1923.

48. Emerson, D. A.: "The Distribution of Marks in High Schools of Varying Size," *School and Society*, vol. XXI, no. 524, January, 1925.
49. Fernald, Walter E.: "Standardized Fields of Inquiry for Clinical Studies of Borderline Defectives," *Mental Hygiene*, vol. I, no. 2, 1917.
50. Fernald, Walter E.: "After-Care Study of the Patients Discharged from Waverley for a Period of Twenty-Five Years," *Ungraded*, vol. 5, no. 2, pp. 25–31, November, 1919.
51. Fernald, Walter E.: "An Out-Patient Clinic in Connection with a State Institution for the Feebleminded," *American Journal of Insanity*, vol. LXXVII, no. 2, p. 233, October, 1920.
52. Franzen, Raymond Hugh: *The Conservation of Talent, Intelligence Tests and School Reorganization.* Yonkers, World Book Co., 1922.
53. Freeman, Frank N.: *Mental Tests.* Boston, Houghton Mifflin, 1926.
54. Freeman, Frank S.: "The Influence of Educational Attainment upon Tests of Intelligence." An unpublished thesis in the Harvard Library, 1926.
55. Freundlich, Erwin: *The Foundations of Einstein's Theory of Gravitation.* English Translation by Henry L. Brose, Introduction by H. H. Turner, pp. 11, 12. Cambridge University Press, 1920.
56. Galton, Francis: *Inquiries into Human Faculty and its Development.* London, Macmillan, 1883.
57. Gordon, Hugh: *Mental Scholastic Tests among Retarded Children.* London, Board of Education, Educational Pamphlets, no. 44, 1923.
58. Gordon, Kate: *The Influence of Heredity on Mental Ability.* Report of the Children's Department, Sacramento State Board of Control, 1921.
59. Haggerty, M. E., and Nash, Harry B.: "Mental Capacity of Children and Paternal Occupation," *Journal of Educational Psychology*, vol. 15, pp. 559–72, 1924.

60. Hart, H.: "The Slowing Up in Growth of Mental Test Ability," *School and Society*, vol. 20, 573–74, 1924.
61. Harvard University, Report by Division of Education, *The Teaching of Economics in Harvard University*. Cambridge, Harvard University Press, 1917.
62. Healy, William: *The Practical Value of Scientific Study of Juvenile Delinquents*. Washington, U.S. Department of Labor, Children's Bureau Publication, 96, 1922.
63. Hincks, Elizabeth: *Disability in Reading and its Relation to Personality*. Harvard Monographs in Education, vol. II, no. 2, Cambridge, Harvard University Press, 1926.
64. Hodgkinson, Lorna: "A State Program for the Diagnosis and Treatment of Atypical Children in Public School Systems." Unpublished thesis, Harvard Library, Harvard University, 1922.
65. Hollingworth, Leta S.: *Special Talents and Defects*. New York, Macmillan, 1923.
66. Hollingworth, L. S., Garrison, C. G., and Burke, Agnes: "The Psychology of a Prodigious Child," *Journal of Applied Psychology*, vol. 1, no. 2, June, 1917.
67. Hollingworth, L. S., Garrison, C. G., and Burke, Agnes: "Subsequent History of E——; Five Years after the Initial Report," *Journal of Applied Psychology*, vol. VI, no. 2, pp. 205–10, 1922.
68. Holzinger, Karl J., and Freeman, Frank N.: "Rejoinder on Burt's Regression Equation," *Journal of Educational Psychology*, vol. 17, pp. 384–86, 1926.
69. Hopkins, L. Thomas: *The Marking System of the College Entrance Examination Board*, Harvard Monographs in Education, vol. I, no. 2. Cambridge, Harvard University Press, 1921.
70. Hopkins, L. Thomas: *The Intelligence of Continuation School Pupils in Massachusetts*. Harvard Studies in Education, no. 5. Cambridge, Harvard University Press, 1924.
71. Huey, Edmund B.: *The Psychology and Pedagogy of Reading*. New York, Macmillan, 1908.
72. Irwin, E. A., and Marks, L. A.: *Fitting the School to the Child*. New York, Macmillan, 1924.

73. James, William: *The Principles of Psychology.* New York, Holt, 1902.

74. Jennings, H. S.: *Prometheus or Biology and the Advancement of Man.* New York, Dutton, 1925.

75. Kelley, Truman L.: *Educational Guidance,* Contributions to Education, no. 71, Teachers College. New York, Columbia University, 1914.

76. Kelly, F. J.: *Teachers' Marks: Their Variability and Standardization.* Contributions to Education, no. 66, Teachers College. New York, Columbia University, 1924.

77. Köhler, Wolfgang: *The Mentality of Apes.* Translated from the second revised edition by Ella Winters. New York, Harcourt-Brace, 1925.

78. Kuhlmann, Fred: "The Present Status of Memory Investigation," *Psychological Bulletin,* vol. v, pp. 285–92, 1908.

79. Langford, Cooper H.: "Studies in the Academic Records of Harvard College." Unpublished study, Harvard University, 1924.

80. Lauterbach, C. E.: "Factors Affecting Teachers' Grading." Unpublished study, Harvard Laboratory of Educational Psychology.

81. Lauterbach, C. E.: "Studies in Twin Resemblance." *Genetics,* vol. 10, November, 1925.

82. Lincoln, E. A.: "The Relative Standing of Pupils in High School, in Early College and on College Entrance Examinations," *School and Society,* vol. v, pp. 417–20, April 7, 1917.

83. Lincoln, E. A.: *Sex Differences in the Growth of American Children.* Philadelphia, Warwick and York, 1927.

84. Lippman, Walter: "A Defence of Education." *Century Magazine,* vol. 106, May, 1923.

85. Lord, Elizabeth E., Carmichael, Leonard and Dearborn, Walter F.: *Special Disabilities in Learning to Read and Write.* Harvard Studies in Educational Psychology and Educational Measurements, vol. II, no. 1, 1925.

86. Lowell, A. Lawrence: "College Studies and Profes-

sional Training," *Educational Review*, vol. 42, October, 1911.

87. Mach, Ernst: *Erkenntnis und Irrtum, Skizzen zur Psychologie der Forschung.* Leipzig, 1906.
88. Matthews, Mabel A.: *One Hundred Institutionally Trained Male Defectives in the Community under Supervision.* National Committee for Mental Hygiene, Reprint no. 145, New York, 1922.
89. Merriman, Curtis: *The Intellectual Resemblance of Twins.* Psychological Monographs, vol. XXXIII, no. 5, whole no. 152, 1924.
90. Miles, W. R.: *Comparison of Elementary and High School Grades.* Studies in Education, vol. 1, no. 1, University of Iowa.
91. Norsworthy, Naomi: *The Psychology of Mentally Deficient Children.* Columbia University Contributions to Philosophy and Psychology, vol. XV, no. 2. New York, Science Press, 1906.
92. O'Shea, M. V., and others: *The Child, His Nature and His Needs.* The Children's Foundation, Valparaiso, Indiana, 1924.
93. Oswald, Wilhelm: *Grosse Männer, Akademische Verlagsgesellschaft.* Leipzig, 1909.
94. Oswald, Wilhelm: "A Review of Grosse Männer by W. R.," *Nature*, July 29, 1909.
95. Pear, T. H.: "The Intellectual Respectability of Muscular Skill," *British Journal of Psychology*, General Section, vol. XII, part 2, pp. 162–80, October, 1921.
96. Pear, T. H.: "Mental Tests and Mentality," *Psyche*, vol. II, no. 4, pp. 304–14, April, 1922.
97. Pear, T. H.: *Remembering and Forgetting*, p. 229. New York, Dutton, 1923.
98. Pintner, R.: "Intelligence as Estimated from Photographs," *Psychological Review*, vol. 25, pp. 286–96, 1918.
99. Pintner, R.: *Intelligence Testing.* New York, Holt, 1923.
100. Porteus, S. D.: *The Vineland Revision.* New Jersey, Publications of the Training School at Vineland, no. 16, 1919.

101. Poull, L. E.: "The Mental Status of Truants," *Ungraded*, vol. v, November, 1919.
102. Prescott, Daniel A.: *The Determination of Anatomical Age in School Children and its Relation to Mental Development.* Harvard Monographs in Education, Series 1, no. 5. Harvard University Press, 1923.
103. Rand, Gertrude: "The Use of the Correlation Graph with Half Sigma Intervals," *Journal of Educational Research*, vol. IX, March, 1924.
104. Rignano, Eugenio: *The Psychology of Reasoning.* New York, Harcourt-Brace, 1923.
105. Root, W. T.: "The Intelligence Quotient from Two Viewpoints," *Journal of Applied Psychology*, vol. VI, pp. 267–75, September, 1922.
106. Root, W. T.: "The Freshman: Thorndike College Entrance Tests, First Semester Grades, Binet Tests," *Journal of Applied Psychology*, vol. VII, pp. 77–92, March, 1923.
107. Russell, Bertrand: "The Meaning of 'Meaning,'" *Mind*, vol. 29, pp. 398–404, N.S., 1920.
108. Smith, F. O.: *A Rational Basis for Determining Fitness for College Entrance.* University of Iowa Studies in Education, vol. 1, no. 3, 1912.
109. Spearman, C.: *The Nature of Intelligence and the Principles of Cognition.* London, Macmillan, 1923.
110. Starch, Daniel: *Educational Psychology.* Macmillan, 1919.
111. Starch, D., and Elliott, E. C.: "Reliability of Grading Work in Mathematics, *School Review*, vol. 21, pp. 254–59, 1913.
112. Stenquist, John L.: *Measurements of Mechanical Ability.* New York, Teachers College, Columbia University, 1923.
113. Stern, William: "The Theory of the Constancy of Intelligence, *Psychological Clinic*, vol. XVI, pp. 110–18, 1925. Translated by H. Klüver from *Neue Beitrage zur Theorie und Praxis der Intelligenzprufung.* Leipzig, 1925.
114. Stevens, W. L.: Unpublished thesis in the Library of

the University of Wisconsin, cited by Starch, *Educational Psychology*. New York, Macmillan, 1919.

115. Stoke, S. M.: "Occupational Groups and Child development." Harvard Monographs in Education, No. 8. Harvard University Press, 1927.

116. Swift, Edgar J.: *Mind in the Making, A Study in Mental Development*. New York, Scribner's, 1908.

117. Teagarden, Florence M.: *A Study of the Upper Limits of the Development of Intelligence*. Contributions to Education, no. 156. New York, Teachers College, Columbia University, 1924.

118. Terman, Lewis M.: *The Measurement of Intelligence*. Boston, Houghton Mifflin, 1916.

119. Terman, Lewis M.: *Intelligence of School Children*. Boston, Houghton Mifflin, 1919.

120. Terman, Lewis M.: "Intelligence and its Measurement: A Symposium," *Journal of Educational Psychology*, vol. XII, no. 3, March, 1921.

121. Thomson, Godfrey H.: *Instinct, Intelligence and Character*. New York, Longmans, Green, 1925.

122. Thomson, Godfrey H.: "The Interpretation of Burt's Regression Equation," *Journal of Educational Psychology*, vol. 17, pp. 301–08, 1926.

123. Thorndike, E. L.: *Educational Psychology*. New York, Teachers College, Columbia University, 1903.

124. Thorndike, E. L.: *Measurements of Twins*. New York, The Science Press, 1905.

125. Thorndike, E. L.: "Intelligence and its Uses," *Harper's Magazine*, vol. CXL, 1920.

126. Thorndike, E. L.: "Intelligence and its Measurements: A Symposium," *Journal of Educational Psychology*, vol. XII, no. 3, 1921.

127. Thorndike, E. L.: "On Improvement in Intelligence Scores from Fourteen to Eighteen," *Journal of Educational Psychology*, vol. 14, pp. 513–16, 1923.

128. Thorndike, E. L.: "The Measurement of Intelligence; The Present Status," *Psychological Review*, vol. 31, pp. 219–52, 1924.

129. Thorndike, E. L., and Bregman, E. O.: "On the Form of the Distribution of Intellect in the Ninth Grade,"

Journal of Educational Research, vol. x, no. 4, November, 1924.

130. Thurstone, L. L.: "The Nature of General Intelligence and Ability," *British Journal of Psychology*, General Section, vol. xiv, part 3, January, 1924.
131. Thurstone, L. L.: *The Nature of Intelligence.* New York, Harcourt-Brace, 1924.
132. Thurstone, L. L.: "A Method of Scaling Psychological and Educational Tests," *Journal of Educational Psychology*, vol. xvi, no. 7, October, 1925.
133. Tredgold, A. F.: *Mental Deficiency.* New York, Wood, 1908.
134. Varner, G. F.: "Improvement in Rating the Intelligence of Pupils," *Journal of Educational Research*, vol. 8, pp. 220–32, 1923.
135. Wallin, J. E. W.: "Classification for Instruction of Mentally Deficient and Retarded Children," *Mental Hygiene*, vol. viii, no. 3, July, 1924.
136. Wentworth, Mary M.: *Individual Differences in the Intelligence of School Children.* Harvard Studies in Education, vol. vii. Cambridge, Harvard University Press, 1926.
137. Whipple, Guy M.: "Endowment, Maturity and Training as Factors in Intelligence Scores," *Scientific Monthly*, vol. xviii, pp. 496–507, May, 1924.
138. Wood, Ben: *Measurement in Higher Education.* Yonkers, World Book Co., 1923.
139. Woodrow, Herbert: *Brightness and Dullness in Children.* Philadelphia, Lippincott, 1919.
140. Wooley, Helen T., and Hart, Hornell: *Feeble-Minded Ex-School Children.* Studies from the Helen A. Trounstine Foundation, vol. i, no. 7, April 1, 1921.
141. Young, Kimball: "The History of Mental Testing," *Pedagogical Seminary*, vol. xxxi, pp. 1–48, March, 1924.
142. Joint Committee on Methods of Preventing Delinquency: *Three Problem Children.* New York.
143. U.S. War Department: *Army Mental Tests, Methods, Typical Results, and Practical Applications.* Washington, D.C., 1918.

INDEX

[redacted]